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# Quarterly Report

## of Selected Research Projects

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United States  
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January 1 to March 31, 1990

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### Crop Production and Protection

Genetic engineering of certain pests and crops may be one step closer to practical use, thanks to a new gene insertion method. It relies on a "recipe" of insect eggs or plant cells, new genes, salt water and tiny silicon whiskers. When this mixture is spun on a lab blender known as a vortex, the needles gently pierce the eggs or cells, making tiny holes that allow the foreign new genes to enter. The technique promises to enable scientists to successfully alter insect eggs or crop cells at the rate of one per hour compared to one per year with microinjection—the technique currently being studied. So far, its developers have transferred either a test gene or dye into fruit flies, house flies, mosquitoes and non-pest *Drosophila* flies. They have shared their technique with university scientists, who have used it successfully to place DNA in citrus.

*Insects Affecting Man and Animals Research Lab,  
Gainesville, FL*

*Andrew F. Cockburn, (904) 374-5873*

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

A new tissue-culture technique will help ease the problems of storing germplasm for crops that are not usually stored as seed, such as sweetpotatoes. Sweetpotatoes stored under conventional tissue culture techniques have to be recultured about every 90 days—a time-consuming, labor-intensive process. But the new technique puts the plants in a state almost like suspended animation. This is done by lowering the storage temperature of the tissue cultured plants to minus 70 degrees F and reducing the carbohydrate level in the growth media from 3 percent to 2 percent. The time between regenerations has already been stretched from 3 to 12 months. Once the plants are removed from storage and planted, they grow again at a normal rate.

*Plant Introduction Research Station, Griffin, GA*

*Robert Jarret, (404) 228-7207*

Genes that help wheat resist the Hessian fly are being "planted" in increasing numbers on a genetic map. As a result, the job of plant breeders to find resistant wheat may be easier. For example, ARS and Moroccan scientists for the first time found a Hessian fly resistance gene on chromosome 2B of a durum wheat used in pastas. This gene should be easy to incorporate into U.S. bread wheats. In another project, scientists made a series of crosses between an old wheat variety and some wheats that lacked one chromosome. In the process, they found that only one chromosome, 5D, can carry the Hessian fly resistance gene. Because of such continuing efforts to pinpoint genetic resistance and incorporate it into wheat breeding lines, the Hessian fly may never again cost U.S. farmers up to \$100 million annually in lost yields.

*Plant Science and Entomology Research,*

*Manhattan, KS*

*Thomas S. Cox/J.H. Hatchett, (913) 532-7260/6154*

Sugar makes an insect-killing bacterial protein stay on the job much longer—instead of being washed away by rain. In a test using simulated rainfall, researchers found that a sugar-starch spray mix kept the bacterial protein on plant foliage up to 19 days. Starch sprays without the sugar flaked or peeled off within 2 to 4 days. Further tests showed that protein of *Bacillus thuringiensis* (Bt), the most common natural product sold as a biocontrol for farm and garden insect pests, remained active against European corn



borers over an 8-day period. It killed up to 90 percent of the insects when the starch-sugar combo was used. Without the sugar and starch, however, Bt formulations killed only 20 percent in 8 days.

*Plant Polymer Research, Northern Regional Research Center, Peoria, IL*

*Michael R. McGuire/Baruch S. Shasha, (309) 685-4011*

**Genetically altered pond scum** might one day lead to a self-regulating fertilizer for rice. The pond scum, or blue-green algae, had been genetically altered by University of Florida scientists in a joint study with ARS to produce ammonia as long as rice plants nearby need it. The scum stops producing ammonia as soon as the rice stops using it. In greenhouse tests, the algae increased rice plant growth eight-fold—as much as commercial fertilizers. In the field, the plants didn't do as well, probably because scientists had used a lab-grown strain of algae. Researchers are now scouring rice fields in Florida for a natural strain that will survive in fields, which they hope to alter to become another on-and-off fertilizer producer.

*Plant Stress and Protection Research Lab, Gainesville, FL*

*Stephan Albrecht, (904) 392-6180*

**A fragment of DNA from a disease that devastates American elms** may help reveal whether the same organism is causing a whole host of plant ills. The culprit, called a mycoplasma-like organism (MLO), is blamed for elm yellows disease. Scientists suspect elm yellows disease may have been the actual killer of some trees previously thought to have succumbed to Dutch elm disease. A tree infected with elm yellows may show no signs of a problem until the tree is beyond saving. But a "probe" made from a DNA fragment from the elm yellows MLO could unmask the telltale MLOs before the tree reaches that point. It also could reveal whether seedlings are infected before they're planted. Within the wider plant world, the probe could provide clues as to that MLO's possible role in other plant diseases. Researchers know that more than 200 plant diseases worldwide are associated with MLOs. But since the same MLO can cause different symptoms in different plants, they're not sure how many MLOs are actually causing problems.

*Microbiology and Plant Pathology Lab, Beltsville, MD*  
*Ing-Ming Lee, (301) 344-2745*

**Miniature potatoes**, called microtubers, may offer biotechnologists a more efficient way to give the plant useful new genes. In a recent test, the little potatoes were sliced into disks and painted with a harmless bacterium that held two "tracer" genes. Tracers don't confer useful agronomic traits but do allow researchers to test whether a method for transferring genes works. It did: Some of the shoots emerging from the disks had the tracers actively working. Scientists now aim to find out if the shoots will grow in the greenhouse and outdoors into healthy plants with the tracers—and the desirable genes of the parent plants—still active. If this happens, using microtubers might prove ideal for transferring genes that confer valuable traits like resistance to bruising or browning.

*Process Biotechnology Research, Western Regional Research Center, Albany, CA*

*Betty Ishida/William Belknap, (415) 559-5726/6072*

**Puerto Rican farmers can now grow cocoa** using growing techniques for spacing, fertilizing and watering developed by ARS scientists. Cocoa could serve as an alternative crop for the island's steep marginal soils and as a replacement for acres once planted in sugarcane. Sugarcane was a long-time island mainstay that has become untenable because of low yields, increased cost of production and reduced market prices. Cocoa meets the island's need for crops suited to small family operations—which can be grown with minimum tillage and without expensive machinery. Growers also could interplant cocoa with plantains, the large banana-like crop grown on the island. The temporary shade from the plantain trees would benefit the cocoa, and the second crop would provide farmers with additional income. The United States has no domestic source of cocoa and in 1988 imported more than \$800 million worth in beans, powder and cocoa butter.

*Tropical Crops and Germplasm Research Lab, Mayaguez, PR*

*Heber Irizarry, (809) 831-3435*

**Puerto Rico will also have the first supersweet corn variety** specifically bred for the island's growing conditions. Bred from another ARS developed variety, the new supersweet corn could help Puerto Rico and regions with similar soil and climate become more self-sufficient in producing food. Currently, the island imports all corn for human consumption. Corn sells in season at island supermarkets for 35 to 45 cents an ear.

*Tropical Crops and Germplasm Research Lab, Mayaguez, PR*

*Salvio Torres-Cardona, (809) 831-3435*



A South African grass may solve a "shattering" problem of forage seed in Texas cattle country. Many acres of Texas pasture are covered with kleingrass, a forage that survives on as little as 15 inches of water annually. But kleingrass seed shatters—drops to the ground—before it can be harvested for planting. It has been estimated that as little as 10 percent of kleingrass seed actually can be harvested because of seed shattering. Grass producers have tried harvesting the seed early to avoid these losses. But that often leads to collection of immature seed that won't produce a good grass crop. However, researchers have found a promising kleingrass strain from South Africa. It appears to retain twice as much of its seed 49 days after flowering as does Selection 75, the standard kleingrass. The South African grass is being evaluated for other desirable characteristics, such as productivity and ability to establish itself, before scientists decide whether to release it as a new cultivar.

*Grass, Soil and Water Research, Temple, TX*  
 Bruce A. Young, (817) 770-6524

**What's wrong with my plant?** One easy way to answer this question is to have a list of possible problems known to affect the plant in question. And now, this list is available in a new publication called "Fungi on Plants and Plant Products in the United States." The book provides up-to-date data on distribution of 13,000 fungi that attack 9,000 vascular (flowering) plants. It also has detailed descriptions and names for each of the fungi and plant hosts. Alternative names for diseases are also listed. Since many fungi are found on a limited number of plants, this list can help scientists and nonscientists identify fungi. Then they can apply appropriate control measures. This publication is part of an ongoing database project that should provide current information on the distribution and host relationships of U.S. fungi.

*Systematic Botany and Mycology Lab, Beltsville, MD*  
 David F. Farr/Amy Y. Rossman, (301) 344-2274

## Soil, Water and Air

**Straw mulches to grow wheat under conservation tillage systems** have gotten a bum rap for the wrong reason. The wheat doesn't grow well, but not because of plant toxins from the rotting straw, as was diagnosed about 40 years ago. The poor growth actually results from microorganisms in the soil and not in the straw. A mixture of three root diseases—take-all (caused by *Gaeumannomyces graminis* var. *tritici*), pythium root rot and rhizoctonia root rot—causes the problem since they are supported by roots of wheat and grass weeds. The straw on the soil surface prevents the soil from drying, encouraging these root diseases to occur in the top 6 inches of soil. These results show how critical it is to control root diseases in order for conservation tillage to be successful in cropping systems where wheat is grown with little or no crop rotation.

*Root Disease and Biological Control Research,*  
 Pullman, WA

R. James Cook, (509) 335-3722

**Encapsulating pesticides or working them into soil** can greatly reduce groundwater pollution on no-till fields. A 3-year study in Maryland showed that in dry years pesticide levels in groundwater were well within the Environmental Protection Agency's health advisory levels on both no-till and conventional-till cornfield plots. But in a year of normal rainfall, water underlying no-till plots had significantly higher concentrations of carbofuran insecticide and the herbicides alachlor, atrazine and cyanazine than water underlying conventionally tilled plots. The most worrisome results came during May 1988 when 2 inches of rain fell over 2 days, beginning just 12 hours after the herbicides were sprayed on the field and a few days after carbofuran had been worked into the soil. Both atrazine and cyanazine levels for both types of tillage were significantly higher than EPA advisory levels. Using alachlor-encapsulated pellets—which allows for slow release, increased efficiency and reduced loss of the herbicide—resulted in much lower levels. Incorporating carbofuran into the soil in a narrow band had the same effect. Exposing it to less soil lowers the odds of its being washed into an underground shortcut to groundwater.

*Hydrology Lab, Beltsville, MD*  
 Tim J. Gish, (301) 344-4378

**Modified cornstarch may be another part of the solution** to the problem of the herbicide atrazine showing up in groundwater in fields where the chemical may be taking a shortcut through soil channels such as root holes, cracks or large pores. A study of 40 soil cores from a cornfield that had been minimally tilled for 8 years showed that encapsulating atrazine in starch reduced leaching losses from 35 percent to less than 1 percent. Researchers applied atrazine alone or an atrazine-modified cornstarch formulation to the soil cores and simulated a half-hour rainfall. Then they analyzed the cores for atrazine leaching. The greatest leaching occurred with the regular atrazine after the first rain, suggesting that normally applied atrazine escapes rapidly through channels rather than filtering slowly through the soil, while encapsulated atrazine was essentially immobile.

*Hydrology Lab, Beltsville, MD*  
Tim J. Gish, (301) 344-4378

**Experimental pastures in Ohio are helping explain** when cattle pastures may become sources of groundwater pollution. In a 5-year study, when 50 pounds of nitrogen per acre were applied, groundwater levels of nitrate-nitrogen never exceeded 10 parts per million, the maximum allowed in EPA guidelines. But 200 pounds per acre raised the levels above the EPA limit. Another test showed that a farmer could graze as many cattle as a pasture could support without adding measurable nitrates to a stream, as long as no fertilizer was applied. This will help scientists find ways farmers can economically produce meat while being kinder to the environment.

*North Appalachian Experimental Watershed,  
Coshocton, OH*  
Lloyd B. Owens, (614) 545-6349

**Is no-till farming a culprit in groundwater pollution?**

Yes and no, according to recent lab tests. Scientists confirmed that water flushes the chemical weed killers atrazine and alachlor down channels formed by the previous crop's roots. But the process is probably less important than suspected. Lab tests were conducted on a silt loam soil typically used for alfalfa and no-till corn rotations in Minnesota, but may apply to much of the Midwest. After constantly flushing the soil with water for 2 days, research-

ers found that less than 5 percent of the herbicides leached to a 2-foot depth while most remained in the top 4 inches. The reason—the herbicides stuck to organic matter and clay or were broken down by microbes near the soil surface.

*Soil and Water Management Research, St. Paul, MN*  
William C. Koskinen, (612) 625-4276

**Midwestern dairy farmers who grow alfalfa can use a** flexible new crop-rotation strategy to stop yield-robbing quackgrass. Because the weed spreads as the alfalfa dies out after a few years, researchers say switching to no-till corn before replanting alfalfa will squelch much of the problem. Then, to control weeds in the corn, researchers tested different options that minimize herbicides while still protecting yields. Instead of making one big application of weed killer, farmers could use the same or smaller amounts in two or three applications. They can wait to see how well each application works before deciding on making another. Three options tested: (1) Glyphosate applied in the fall and any of several triazine herbicides applied after corn planting; (2) Triazine 3 weeks before planting and again after planting; and (3) Triazine at planting and a month later. Relying on just triazine should be avoided, because enough herbicide may persist after a dry year to delay rotation to the next alfalfa crop.

*Plant Science Research, St. Paul, MN*  
Douglas D. Buhler, (612) 625-6719

**Chisel plowing can help farmers get rid of weed seeds.**

Because the seeds remain within 4 inches of the surface, they are much more likely to be eaten by predators, sprout and be killed by herbicides or simply rot. Moldboard plowing, by contrast, merely postpones weed problems. It buries most of the seeds 4 to 12 inches deep—where they lie dormant until the next plowing or even years later. To gauge movement and fate of seeds, ARS and University of Minnesota researchers scattered equal numbers of real seeds and ceramic beads—"tracer" seeds—before moldboard or chisel plowing. Ten months later, they found that chisel plowed soil had less than half as many real seeds as tracers, while moldboard plowing yielded two-thirds as many. The difference means that more seeds survived the moldboard plowing.

*Soil and Water Management Research, St. Paul, MN*  
Raymond R. Allmaras, (612) 625-1742



## **Insect and Weed Research**

**The newest fashion for boll weevils** is a light coat of Day-Glo dyes. These powdered dyes, when mixed with sand or corncob grit, help scientists identify boll weevils after they have been released in the field. Entomologists release weevils when studying the effectiveness of techniques to sterilize male insects, or the diets used to mass-rear insects. Different dye colors—which fluoresce under ultraviolet light—help researchers quickly identify marked weevils that have been captured in field traps or used in lab experiments. The weevils can be harmlessly and lightly coated by shaking them with the dye and sand mixture for a few seconds. An alternative method coats them as they walk on a mixture of dye and corncob grit for about 2 hours. The labeling technique can also be used for other insects.

*Insect Rearing Research, Mississippi State, MS*  
*John P. Reinecke, (601) 323-2230*

**Viruses that infect insects remain active as pest-fighters longer** if encapsulated in starch and a protectant against the sun's ultraviolet (UV) rays. Scientists have long known that sunlight inactivates many microbial pesticides. But researchers working with a nuclear polyhedrosis virus of *Heliothis* insects—a group that includes tobacco budworm and many other crop pests—developed four different UV-starch formulations to slow this inactivation. For instance, separate preparations made with activated carbon, Congo Red dye, a fluorescent whitening agent and a substance made from tree bark were 5 to 10 times more effective against tobacco budworm larvae than a formulation without these UV protectants. Formulations of this type could provide farmers with more effective microbial pesticides.

*Biological Control of Insects Research Lab,*  
*Columbia, MO*

*Carlo M. Ignoffo, (314) 875-5361*

**A fungus that kills only jimsonweed** can now be induced to also destroy or severely damage at least four other annual weeds that give farmers perennial headaches. Scientists have known that the leaf-spotting fungus, *Alternaria crassa*, kills or damages Eastern black nightshade, hemp sesbania and showy croton when its spores are exposed to fruit pectin. But now, researchers can damage or kill the same weeds plus cocklebur weeds with a solution of the fungus and jimsonweed tissue. Without the jimsonweed, all four weeds were previously resistant to the fungus. The discovery is one of the first reports of a non-

genetic modification of a plant pathogen and makes further development of the fungus as a multi-target biological herbicide economically feasible. Small scale field tests are planned for this summer.

*Southern Weed Science Lab, Stoneville, MS*  
*C. Douglas Boyette, (601) 686-2311*

**The fall armyworm**—a voracious crop pest—could be controlled with a double knockout punch. Punch one: Corn silks from Zapalote Chico, a Mexican corn that resists attack from insect pests. Punch two: A pair of insects—a parasitic wasp named *Camponotus sonorensis* and an aggressive predator of fall armyworm called the insidious flower bug. This combo—plant resistance and biological control—works in the lab because when the armyworm larvae are fed silks from the resistant corn, their growth is stunted to a size the wasp can more easily parasitize. In cooperative greenhouse studies with the University of Georgia, the flower bug killed 9 times more of these smaller larvae. If this technique can be transferred outside the lab, it could reduce the pesticides now used to control fall armyworms. At present, Zapalote Chico corn is not grown in the United States, but ARS geneticists are attempting to breed hybrid corns with similar built-in natural controls.

*Insect Biology and Population Management Research Lab, Tifton, GA*  
*Billy R. Wiseman, (912) 387-2320*

**When quackgrass dies, it doesn't go alone**—it takes slimy, crop-damaging slugs with it. Quackgrass, one of the world's most persistent weeds, releases a chemical compound into the soil when it is killed. This compound in turn acts as a nerve poison to slugs, although it causes no ill effects in freshwater snails or other creatures. The compound is not found in living quackgrass. Researchers have isolated and produced an artificial copy of the compound, which may someday be produced commercially as a poison bait for slugs. Slug-killing compounds on the market today are toxic to birds and animals. Researchers say the quackgrass compound could be applied at much lower rates and would be less expensive to use. This compound has been field-tested for 2 years in snapbeans, alfalfa and other crops; snapbean yields nearly doubled as a result of reduced slug damage. Slugs also cause substantial damage in West Coast strawberry fields and citrus orchards, as well as interfering with corn production on the East Coast.

*Plant Protection Research, Ithaca, NY*  
*Roger D. Hagin, (607) 255-1712*

## **Animal Production and Protection**

**Finding a fast and accurate diagnosis for swine dysentery** is the key to eradicating this disease that causes heavy losses for U.S. hog farmers. An ARS-developed DNA probe cuts the time required to identify *Treponema hyodysenteriae*—the bacterium that causes the disease—from 6 to 2 days. This rapid method of detecting the bacterium is likely to play an important role in launching an eradication program. Swine dysentery has been reported in every major hog-producing country in the world.  
(PATENT)

*National Animal Disease Center, Ames, IA*  
Neil S. Jensen, (515) 239-8242

**Bigger isn't always better** when producing cattle in a demanding environment. Preliminary findings from a 9-year study of Angus beef cattle indicate that cows that weigh less at maturity may outperform their heavier sisters in a setting where forage is scant or nutritionally inadequate. In a study of about 220 Angus cows per year in central Florida, smaller cows of all ages had an average reproduction rate of 85 percent, compared with 80 percent for larger animals. When all calves produced by each cow were weaned and their combined weights totaled, the smaller cows produced an average of 1,072 pounds of weaned weight, compared to 950 pounds for the calves from larger cows. Although calves from the larger cows typically outweighed offspring from the smaller cows, the latter's higher rate of reproduction boosted their calf weight totals. Researchers say the key may be that a larger cow requires so much more energy that less is left over for functions such as reproduction. Thus, when nursing their first calves, they are less likely to get pregnant during their second breeding season when grazing on scarce, poor quality forage.

*Subtropical Agricultural Research, Brooksville, FL*  
Jorge J. Beltran, (904) 796-3385

**A live, genetically engineered intestinal bacterium** has been used in an experimental vaccine to fight coccidiosis in chickens. Administered orally, the harmless, altered bacterium *Escherichia coli* gave chickens significant protection against this deadly parasite. Initial tests results may provide leads to developing effective vaccines against avian coccidiosis, which costs U.S. poultry farmers \$300 million annually for medication and lower weight gain in chickens. Genes from the coccidial parasite were inserted into a strain of the common intestinal bacteria *E. coli*. When chickens were inoculated with the new bacterium, the bacterium could not reproduce but the chickens produced immune cells in response to it. Then, when the birds were infected with the coccidia parasites, the immune cells killed up to 70 percent of the parasites.

*Biosystematics Parasitology Lab, Beltsville, MD*  
Mark C. Jenkins, (301) 344-8054

**When cows are producing milk**, researchers discovered, cells in their mammary glands are more receptive to thyroid hormone than are the other body cells. At the same time, other body organs receive lower—but still adequate—amounts of this hormone, which helps regulate metabolism and growth. Growth hormone injections amplify these effects. The discovery of the thyroid-hormone cells connections helps solve one more piece of the puzzle that is lactation. It helps explain why a lactating cow uses more of her food energy to produce milk instead of fat or muscle.

*Milk Secretion and Mastitis Lab, Beltsville, MD*  
Anthony V. Capuco, (301) 344-1672

**More lean pork was produced** by all 24 pigs given an experimental feed additive, ractopamine. The biggest gain in lean meat and greatest fat reduction were in an experimental strain of pigs that normally produce fatter meat on a low protein diet. When these animals reached 200 pounds they had 17 percent more protein and 31 percent less fat in their muscle tissue than a control group fed the same rations without ractopamine. These results suggest that a farmer could use the additive to boost the production of leaner hogs. Developed by a private firm, ractopamine has yet to be approved by the Food and Drug Administration for on-farm use.

*Non-Ruminant Animal Nutrition Lab, Beltsville, MD*  
Alva D. Mitchell, (301) 344-2868



Waste from electric generating plants may be a potential fertilizer for crops used for livestock feed. Pigs were safely fed mixtures of corn, wheat and soybeans originally fertilized with electric power plant residues. These wastes came from power plants using fluidized bed combustion of coal, a process that significantly reduces acid rain pollution. Neither the pigs' blood nor body tissues tested at the end of the study showed any unusual or harmful concentrations of chemicals. Fluidized bed combustion is a process in which finely ground limestone is mixed with coal and suspended in a combustion chamber by jets of air. Part of the coal doesn't burn and combines with calcium in the limestone to form a solid residue. Sulfur, lime and other chemicals in the residue can be used to fertilize crops.

*U.S. Regional Pasture Research Lab, State College, PA  
William L. Stout, (814) 863-0947*

### New and Improved Products

Farmers can improve the quality of U.S. cotton—and thereby increase their income—by planting varieties that are easy to clean at the gin. Traditionally, nearly all cotton grown and spindle-harvested in the United States is cleaned with the same number of gin machines—usually seven. This is done regardless of the crop's initial content of leaves, sticks and other plant parts because this "trash" is more difficult to remove from some varieties. This can result in overcleaned cotton. Researchers know that small hairs on the leaves of some cotton varieties become entangled with cotton fiber, making them more difficult to separate from the fiber during processing. But, an ongoing study over 7 years indicates that smooth-leaf cotton varieties need one or two fewer gin cleaning machines than hairy-leaf cottons. By planting smooth-leaf varieties and telling gin operators about them, growers will have a higher-quality cotton to sell and ginneries will see lower operating costs.

*U.S. Cotton Ginning Lab, Stoneville, MS  
W. Stanley Anthony, (601) 686-2385*

A hormone called cytokinin may hold the key to slowing down the natural aging of plants. Vital clues about how to boost cytokinin levels and further delay aging may come from experiments by ARS scientists using new monoclonal antibody probes. The researchers have applied for a patent for the probes, which may reveal how to trick plants into prolonging their growth by using more of the inactive form of cytokinin that is stored by the plant. This longer life would give plants like wheat a little extra time to pack more rich nutrients into each kernel, increasing crop value.

(PATENT)

*Food Safety Research, Western Regional Research  
Center, Albany, CA*

*David L. Brandon, (415) 559-5783*

*Plant Development-Quality Research, Western Regional  
Research Center, Albany, CA*

*Joseph W. Corse, (415) 559-5758*

The sweet, light flavor of high-quality fresh pineapple is largely the work of nine aroma compounds. In tests using sophisticated lab devices and a "sensory panel" of volunteers, one of these natural chemicals, ethyl 2-methylbutanoate, was so potent that the nose could detect it at 6 parts per trillion. (Equivalent to six grains of sugar in an Olympic-size swimming pool.) Researchers ranked the nine compounds so producers of pineapple-based foods can use them to objectively check quality. The ranking can also guide development of superior pineapple varieties through conventional breeding or genetic engineering.

*Food Quality Research, Western Regional Research Center, Albany, CA*

*Gary R. Takeoka, (415) 559-5668*

Just because peanuts are big doesn't mean they are mature on the inside—even though kernel size is currently used as a basis for marketing. ARS scientists found that physical characteristics and chemical reactions inside the kernel differ when roasting immature and mature peanut kernels. Immature kernels tend to be darker than mature kernels when roasted and have less potential for full flavor. Factors such as protein, carbohydrate and oil levels can affect peanut flavor, and the proper balance in composition and quantity is essential. Ultimately, scientists want to determine the optimum balance of these components needed to produce better-tasting roasted peanuts. Understanding the connection between maturity and flavor should help the peanut industry produce a more uniform product.

*National Peanut Research Lab, Dawson, GA*

*Timothy H. Sanders, (912) 995-4441*

## Scientific Information Systems

A new computer program will give winter wheat farmers across the nation a larger picture of the best time to fertilize. Knowing exactly when and how much fertilizer to apply reduces wastes and benefits the environment as well. An earlier computer program, PLANTEMP, predicts when each plant part—roots, shoots and leaves—will appear, based on weather data. Modular Winter Wheat, the new program, accounts for factors that influence photosynthesis rates—like intercepted light, water and nutrient availability. As a result, MWW can also predict the size of each plant part. That will let farmers estimate plant size based on their region's most limiting factor (for example, water in dryland areas). They can then match spring fertilizer applications to amount of available water. The new program should be available for researchers and farmers in about 2 years.

*Columbia Plateau Conservation Research Center, Pendleton, OR*

*Ronald W. Rickman, (503) 276-3811*

A new, simplified equation for designing grassy strips around crop fields will help farmers control erosion and reduce pollution in nearby lakes and streams. Farmers now plant these grassy strips around fields to serve as sediment traps. How well the strips work depends upon their width, the density of the grass and the source and amount of runoff. ARS researchers—in cooperation with scientists at the University of Minnesota, the University of Missouri and USDA's Soil Conservation Service—have devised an easier way to calculate the size of strip needed, using an extension of the agency's CREAMS computer model. Then they developed a procedure so conservation workers can make simple, rapid hand calculations on site.

*National Soil Erosion Research Lab, West Lafayette, IN*  
*Dennis C. Flanagan, (317) 494-6596*



Food processors can use a new ARS computer program to drastically cut the number of lab tests now required to monitor bacterial levels in foods. While not 100 percent accurate, the computer program could cut by 75 percent the number of tests needed to track the growth of *Salmonella* and *Listeria*—two food-poisoning bacteria found in meat and dairy products. It predicts how factors such as acidity and salt influence bacterial growth. The program is being refined so it can also track the bacteria *Shigella*, *Aeromonas* and *Staphylococcus*. About 300 companies are interested in using it.

*Microbial Food Safety, Philadelphia, PA*  
Robert Buchanan, (215) 233-6620

An unusual application of a computer-aided engineering program used to crash-test automobiles could improve the milling of wheat. The program three-dimensionally simulates and analyzes what happens to wheat kernels when they are crushed and ground. The results could lead to new tactics for separating the kernel's bran layer from the inner, flour-producing endosperm. This would increase flour yields and reduce milling costs. Repeated steps currently used to pry away the bran from kernels waste energy, according to ARS and Washington State University scientists conducting the research.

*Food Quality Research, Western Regional Research Center, Albany, CA*  
Gregory M. Glenn, (415) 559-5677  
Department of Agricultural Engineering, Washington State University, Pullman, WA  
Marvin J. Pitts, (509) 335-3243

## Human Nutrition

Fresh broccoli—a salad bar favorite—is an excellent source of vitamin C. Recent analyses show that four ounces have as much vitamin C as an 8-ounce glass of frozen reconstituted orange juice—about 100 milligrams. If the florettes are a very fresh, deep bluish-green, they could contain an extra 40 mg. But freezing and cooking slash vitamin C content more than half, researchers found. And, contrary to popular belief, it doesn't matter how long broccoli is cooked or how much water is used. Most of the loss occurs in the first few minutes of boiling, so blanching does not conserve the vitamin. Nor does steaming: Vitamin C loss was the same in 1/4 cup of boiling water as in 4 cups. The analyses also show that broccoli's vitamin C content at the dinner table is probably lower than USDA food composition tables and other lab-derived values, for which vegetables are cooked in distilled water. Metals in tap water destroy some of the vitamin—about 20 percent according to limited analyses.

*Nutrient Composition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD*  
Joseph T. Vanderslice, (301) 344-2370

Routine pasteurization protects milk from *Listeria monocytogenes*, a bacterium implicated in food-poisoning outbreaks in the United States and Canada. A joint study by ARS and the Food and Drug Administration verified that pasteurization—long used to make milk safe from a variety of bacteria—kills the *Listeria* microorganism that causes a potentially fatal intestinal disease, listeriosis. The pathogen had never been found in pasteurized milk. In the study, researchers tested bacterial strains isolated from a 1983 outbreak; these strains did not survive pasteurization. *L. monocytogenes* organism is known to grow during chilled storage and can infect cooked and ready-to-eat products. The organism often occurs in raw milk and vegetables, cheese, ice cream, fermented sausages and seafood. Listeriosis victims often believe they just have the flu and don't seek medical help. High-risk groups include adults with weakened immune systems as well as newborns and unborn fetuses.

*National Animal Disease Center, Ames, IA*  
Irene V. Wesley, (515) 239-8291

**More on *Listeria*...** In studies of fresh beef, researchers stopped *Listeria monocytogenes* growth for 28 days under normal refrigeration by first dipping the meat in a diluted solution of bacteriocin. The researchers then challenged the meat with *Listeria* every 7 days. Bacteriocin is derived from a starter culture used in making some fermented meat products such as pepperoni and summer sausage. Some processed meats are already being inoculated with bacteriocin-producing bacteria. The compound, not yet approved in its pure form, is similar to nisin, which the Food and Drug Administration has approved as a food additive. Besides causing disease in humans, *L. monocytogenes* is known to be a pathogen of warm-blooded animals, causing meningitis, encephalitis, abortion and occasionally a blood infection. The pathogen has also been identified in birds and fish. The next step: Isolate and characterize bacteriocin's anti-bacterial spectrum.

*U.S. Meat Animal Research Center, Clay Center, NE*  
*Jerry W. Nielsen, (402) 762-4223*

**Certain carbohydrates should reduce** a person's chance of developing diabetes because they keep blood glucose and insulin levels from spiking after a meal. Both fructose and high-amylose starch have shown this dampening effect in a number of studies. To find out which of these two carbohydrates is better at improving glucose tolerance, 21 men, 10 of whom had elevated insulin levels foreboding diabetes, volunteered to find out. They ate one or the other of the carbohydrates as part of breakfast, lunch and dinner for 5 weeks each. The fructose-containing meals were most effective at holding glucose and insulin in check in all the men. But, the meals tended to reduce insulin's efficiency in the 10 men with high insulin. And triglyceride, LDL cholesterol and uric acid—all risk factors for heart disease—were higher in these men when fed fructose-based meals. This suggests that the benefits of fructose probably don't outweigh the risks to those who already have elevated insulin.

*Carbohydrate Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD*  
*Sheldon Reiser, (301) 344-2396*

**Add a little spice to your life;** it may improve your blood sugar level. Tests show that cinnamon, apple pie spice, cloves, bay leaves and turmeric can do more than just enhance the flavor and aroma of food. Extracts of each of these spices tripled insulin's performance in getting glucose metabolized in a widely used test tube assay of insulin activity. Researchers have purified the active ingredient in cinnamon to about 95 percent, but don't yet know what it is. How much of these spices are needed to improve a person's blood sugar level is also unknown because human studies have not been done. But adding some extra spice to healthful foods certainly won't hurt.

*Vitamin and Mineral Lab, Beltsville Human Nutrition Research Center, Beltsville, MD*  
*Richard A. Anderson, (301) 344-2091*

**Even a mild case of iron deficiency in infants and children** can be detected in its early stages with a new test that's easy to administer for research studies. Marginal iron deficiency is a worldwide problem for high-risk groups such as children, adolescents and women of child-bearing age—particularly pregnant women. The new test requires only a drop of blood, taken by pricking the finger. Current tests require about one-third of a teaspoon drawn by a needle from a vein. The new test measures the number of receptors in blood plasma for a protein known as transferrin. Transferrin, which delivers iron through the bloodstream, releases it inside a body cell after passing through the receptors. The number of receptors correlates to the presence or absence of iron deficiency. This research tool is also useful in studying the body's need for iron at various developmental stages so doctors and nutritionists can make recommendations to increase or limit dietary iron.

*Children's Nutrition Research Center, Houston, TX*  
*Buford Nichols, (713) 798-7000*

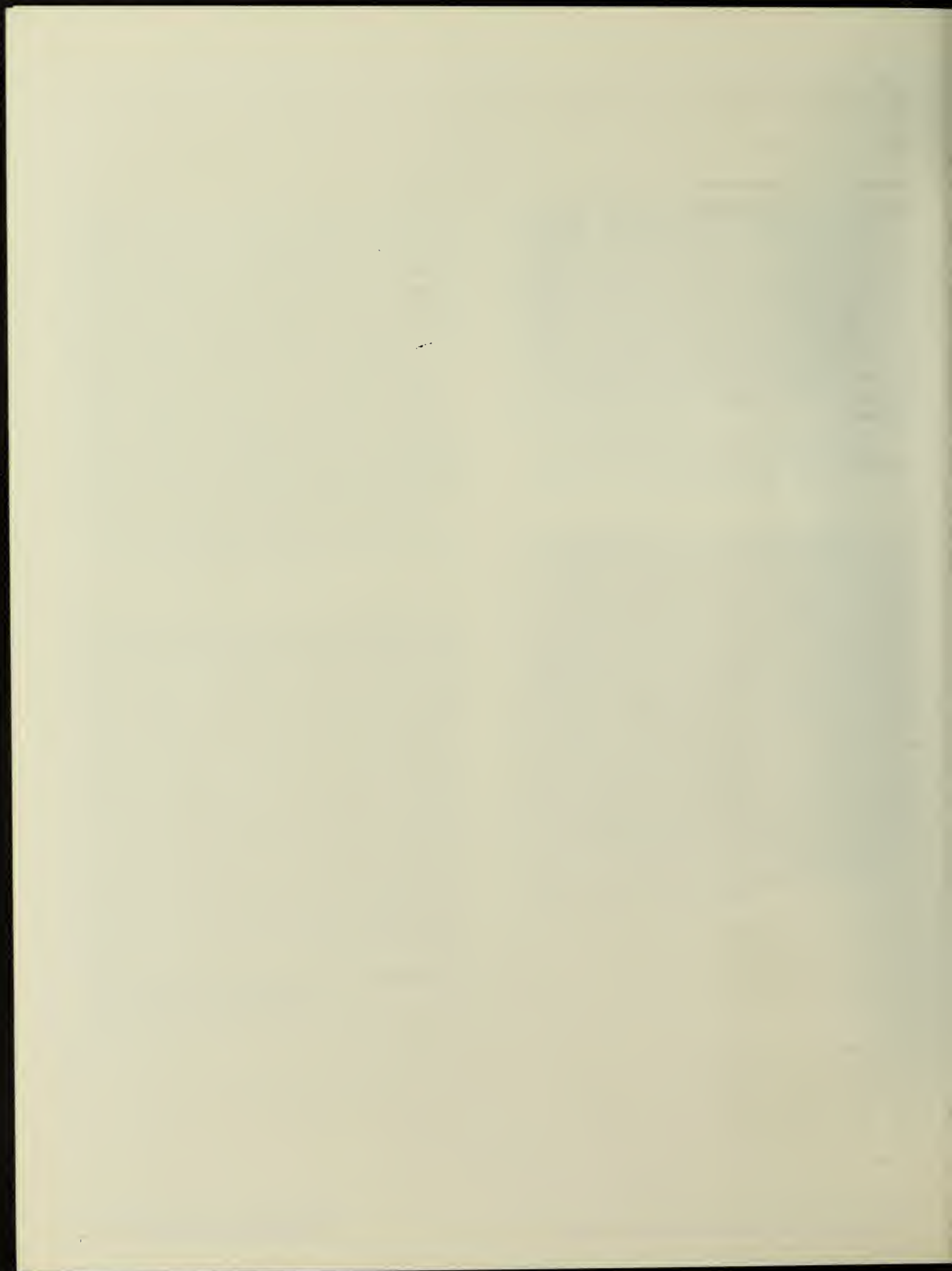


Athletes who get recommended levels of copper, iron and zinc through their diets—and many of them do—don't need to take supplements. These essential trace elements help regulate the body's use of energy and thus take on added importance during physical training. A 6-month study of college men and women found that, during intense training, competitive swimmers didn't need more of the elements than nonathletic students. Blood indicators of copper, iron and zinc were normal for both groups and didn't change throughout the athletes' training period. The collegians in this study got their essential nutrients from food, not supplements.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Henry C. Lukaski, (701) 795-8429*

A very low boron intake has again been shown to cause brain wave changes like those that occur when a person becomes drowsy. The latest evidence—from a 6-month study of 13 women—supports earlier findings that when dietary boron is dramatically reduced, there are distinct changes in EEG's (electroencephalograms). The low-boron diets contained no fruits or natural fruit juices and only a few vegetables in very small portions. In addition, further results from the earlier study indicate that boron deficiency seems to have an effect on motor performance. Women in this study group could not tap their finger as fast, track a target as accurately with a joy stick or respond as quickly when asked to search a field of letters for specific items. Boron is most abundant in apples, pears, grapes and several vegetables. So fast-food fare, even with a lettuce and tomato salad, would not contain much of the element.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
James G. Penland, (701) 795-8471*



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# Quarterly Report

## of Selected Research Projects

United States  
Department of  
Agriculture



Agricultural  
Research  
Service

April 1 to June 30, 1990

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### New and Improved Products

Impregnating insulation with cockroach repellants could be one strategy to cockroach-proof homes and commercial buildings in the future. Under a technology transfer agreement with ARS, Air Vent of Peoria, Illinois, will impregnate insulation with ARS-developed and patented cockroach repellants. The repellants are so strong that in tests, cockroaches choose to stay in bright light and starve to death rather than enter an area treated with the chemicals. ARS scientists will test the treated insulation in Florida homes with severe cockroach infestations. If it proves successful at keeping cockroaches away, it might be marketed by Air Vent's parent company, CertainTeed of Valley Forge, Pennsylvania. The cooperators envision builders installing the insulation in new homes so cockroaches will not invade them. For older homes, pest control operators could replace old insulation with the cockroach-repulsive type.

*Insects Affecting Man and Animals Research Lab,  
Gainesville, FL  
Richard J. Brenner, (904) 374-5937*

Cockroaches don't like a breeze, studies show. Builders wanting to cockroach-proof a home could incorporate airflow into attics and wall voids, where the insects aggregate. Scientists conducted tests in a divided attic inhabited by equal numbers of cockroaches on both sides. On one side, they installed ridge vents to create airflow; the other side they left unventilated. Within 2 weeks, most of the cockroaches had moved to the still side. Scientists believe it's because air is too drying to a cockroach, which requires moisture to survive. This work is part of an overall effort to control cockroach infestations, thereby reducing the incidence of cockroach-related allergy, which affects an estimated 10 to 15 million Americans.

*Insects Affecting Man and Animals Research Lab,  
Gainesville, FL  
Richard J. Brenner, (904) 374-5937*

An edible, inexpensive coating that can be easily applied to fresh fruit and vegetables retards ripening without reducing quality. ARS scientists added an emulsifier to a commercially available, vegetable-oil-based coating. As a result of the emulsifier, which disperses fat globules in water, the new coating increased shelf life of tomatoes, Florida-grown carambola and oranges. Scientists have successfully treated other fruits and vegetables. The coating allows produce to be stored at 70 degrees F, room temperature. Juice from coated oranges, stored for 8 to 10 days, contained up to 14 times more of the usual flavor volatiles. Patent application will be filed. (PATENT)

*Citrus and Subtropical Products Research Lab,  
Winter Haven, FL  
Myrna O. Nisperos-Carriedo, (813) 293-4133*

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

Apple packers can cut bruising by at least 50 percent by modifying grading and bagging equipment. Some simple changes also improved the USDA grade of apples 35 percent. Installing shag carpeting under the conveyor belt of a commercial grading and packing line softened the blow to falling apples. A vinyl material called Nomad, normally used as a floor matting, cut bruising when applied to equipment surfaces such as deflectors made of metal. And other improvements gave the apples a gentler drop into the packing bag. The changes were made permanent

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at the commercial packing line where the study was conducted. Bruise damage is a primary cause of quality and grade loss of apples headed for the fresh market.

*Fruit and Vegetable Harvesting Research,  
East Lansing, MI  
Dale E. Marshall, (517) 353-5201*

**Two new peach varieties** will be released by ARS to nurseries this year. Both varieties ripen in early June in central Georgia, where they were developed. Goldprince, a yellow-fleshed peach, could replace Junegold, an old variety that produces unmarketable fruit some years. Scarletpearl is firmer and redder than most other white-fleshed peaches and is suitable for medium-distance shipping as well as local sales. Both varieties are recommended for peach growers from Texas to North Carolina.

*Southeastern Fruit and Tree Nut Research Lab,  
Byron, GA  
William R. Okie, (912) 956-5656*

**The right packaging could help midwestern grape growers** trying to compete in the California-dominated table grape market. Venus, Reliance and Saturn, seedless grape varieties from the Arkansas Agricultural Experiment Station, can be held at 37.4 degrees F for only 4 weeks before any apparent quality loss. Researchers found, however, that Saturn fared best after 6 weeks in cardboard boxes with shrink-wrap covers. Saturn showed the greatest potential of the three for long-distance shipment and storage without sulfur dioxide to control mold. Plastic dome-lid boxes with vent holes rated second best. Purple net bags, often used for California table grapes at retail markets to prevent loose grapes from falling, proved poor safeguards for all varieties.

*South Central Agricultural Research Lab, Lane, OK  
Penelope Perkins-Veazie, (405) 889-7395*

**A new type of trellis** could increase the yield of machine-harvested eastern thornless blackberries. These berry vines, which need the support of a trellis, have traditionally been harvested by hand. An ARS horticulturist is growing the berries on modified T- and Y-shaped trellises instead of the traditional vertical system. First-year vegetative blackberry canes and second-year fruit-producing canes are trained to grow on separate sides of the trellis. This results in more efficient harvesting since the machine shakes only the fruit-bearing canes. The harvester's catching unit, which passes below the fruiting canes, reduces loss by keeping fruit from falling to the ground.

*Appalachian Fruit Research Station, Kearneysville, WV  
Fumiomi Takeda, (304) 725-3451*

**Redcrest, a new strawberry** developed by ARS scientists, keeps its vivid red color even after it's sliced, frozen and thawed for gelatin or ice cream toppings. The berry's firm texture makes it ideal for jams and jellies, as well. The green cap and hull separate easily from the ripened berry, which hastens handling by pickers and packers. Redcrest berries, which will grow only in the Pacific Northwest, ripen slightly later than other varieties, giving packers the bonus of a late-season harvest. The vines equal or exceed the yields of their popular counterparts. Redcrest may also be useful for breeding other new strawberries with improved color and texture.

*National Clonal Germplasm Repository, Corvallis, OR  
Francis J. Lawrence, (503) 757-4448*

**Certain strains of yeast can protect apples and pears** from fungal decay while in storage. Found naturally on leaves and fruit, the yeasts could become safe and effective alternatives to fungicides that control blue and gray mold and mucor rot. The yeasts work well at low temperatures and oxygen levels—the optimum conditions for long-term apple storage. ARS scientists screened more than 175 yeast and bacteria strains to pinpoint four, all in the genus *Cryptococcus*, that give the best control. Further research seeks to understand exactly how the yeasts work, as well as practical ways to produce, store and apply the mold inhibitors on a commercial scale.

*Production, Harvesting and Handling of Tree Fruits,  
Wenatchee, WA  
Rodney G. Roberts, (509) 664-2280*

**Within the rice industry**, it's known that a chemical reaction in stored rice affects how sticky it can be. An ARS scientist has found out why. At higher storage temperatures, proteins in rice bind much less with starch, making rice less sticky when cooked. At lower temperatures, proteins and starch interact more, making rice more sticky. Chemical changes in the proteins and starch of rice stored at room temperature have a bearing not only on stickiness, but also on color, hardness and fragility. Rice stored at high temperatures tends to yellow. Rice companies could track the chemical changes to determine the level of stickiness of rice under various storage conditions.

*Food Systems Research Lab, Southern Regional  
Research Center, New Orleans, LA  
Joseph Chrastil, (504) 286-4257*



By mixing water, non-fat dry milk, cream and other ingredients, ARS scientists have developed chocolate and vanilla shakes containing only 6 percent sugar. A typical milkshake has 10 to 12 percent sugar. This low-sugar beverage was designed as an alternative to the fluid-milk requirement of the Type A school lunch. The shake provides all the nutrients of fluid whole milk with no more sugar than that found in chocolate milk. When served from a milkshake machine, the beverage has the texture of milkshakes. A study at two high schools showed that students accepted the lower sugar shake.

*Milk Components Utilization Research,  
Eastern Regional Research Center, Philadelphia, PA  
Virginia Holsinger, (215) 233-6703*

Carbohydrate-sensitive consumers may soon benefit from food products made with a special strain of cornstarch. It keeps insulin levels from taking drastic swings. If satisfactory products can be formulated by ARS scientists, these specialty-starch products could lead to less production and more efficient use of insulin by the body. Among the products being tested are specially designed corn chips, corn muffins, bran muffins and shortbread cookies.

*Carbohydrate Nutrition Lab, Beltsville, MD  
Kay Behall, (301) 344-2385*

Adding potato starch gel to low-fat ground beef results in a tender and juicy burger. ARS scientists found that starch gel, which is used now as a thickener in salad dressings, increases cooking yields by binding the water with the meat, which is important to the fast-food industry. Burgers containing the additive actually cook faster than pure beef. The faster cooking and increased moisture retention create cooked patties with 4.5 percent less fat than cooked all-beef burgers. A trained taste panel considered these burgers to have the good-flavor characteristics of all-beef burgers. The starch-gel has been approved for use in food by the Food and Drug Administration; however, both FDA and USDA's Food Safety and Inspection Service would need to approve its specific use in meat before it can be sold for public consumption.

*Meat Science Research Lab, Beltsville, MD  
Bradford W. Berry, (301) 344-1994*

Manipulating the genes responsible for making four proteins in soybeans should enable researchers to improve the quality of the crop's oil. The oil forms in little droplets inside the bean, thanks to the proteins contained in each droplet's outer membrane, or wrapping. Now that researchers have cloned the genes for these "packaging proteins," they will study the ways these genes' activities are regulated, how they are turned on and off, and how they are affected by circumstances such as drought or heat stress. Future payoff: The genes might one day be altered to change the composition of the oil inside the droplet, for example, to reduce the oil's tendency to quickly turn rancid. The United States annually exports about 1.5 billion pounds of soybean oil, and improvements in its shelf life could help expand overseas sales.

*Plant Molecular Biology Lab, Beltsville, MD  
Eliot M. Herman, (301) 344-3258*

ARS has patented a way to significantly reduce levels of natural poisons made by bacteria found on cotton plants. Poisons called endotoxins are believed to be a cause of byssinosis, a lung disease found in some cotton textile workers. Workers can inhale the toxin from dust created when cotton travels through various processing steps. The bacteria, *Enterobacter agglomerans* and *Pseudomonas syringa*, are apparently more likely to contaminate cotton fields when weather is hot and humid. The bacteria invade cotton plants soon after the boll opens and remain through harvesting. But scientists found that giving cotton a bath in sodium hydroxide and alcohol after ginning can eliminate endotoxin before it reaches the mill where the fibers are spun into yarn. Sodium hydroxide is an ingredient found in many household cleaners. Scientists analyzed the treated cotton and found that toxin levels were reduced by 85 to 95 percent. Treated cotton dust has been tested on animals, which showed no ill effect. (PATENT)

*Composition and Properties Research Lab,  
Southern Regional Research Center, New Orleans, LA  
Linda Domelsmith, (504) 286-4282*

Primrose oil can be extracted more safely and quickly without using chemical solvents. Proponents tout the oil, which can cost up to \$22 an ounce, as a remedy for such ailments as high blood pressure and premenstrual pain. Extracting the oil with solvents can take 40 minutes or longer and often leaves chemical residues. Researchers found that supercritical fluid extraction, which relies on highly compressed gases such as carbon dioxide, extract this oil up to four times faster. ARS chemists used this technology to remove 95 percent of the oil in 10 minutes at 122 degrees F and 10,000 pounds of pressure per square inch.

*Food Physical Chemistry Research,  
Northern Regional Research Center, Peoria, IL  
Jerry W. King, (309) 685-4011*

Multicolored lilies will be available year round thanks to a new temperature treatment. Conventional lily production, taking up to 3 years, leaves bulbs vulnerable to disease, insect infestation and summer sprouting that can lower plant quality. That time can now be reduced to about 280 days. Bulbils, tiny bulbs that appear on the plant stem after flowering, are subjected to low-high-low temperatures in peat moss before potting. Researchers have developed nine new lily varieties—brilliant red, creamy yellow and bright lavender—that respond to the treatment. These varieties will be introduced to nurseries this year. (PATENT)

*Florist and Nursery Crops Lab, Beltsville, MD  
Mark S. Roh, (301) 344-3570*

Iris bulbs reveal their showy blooms 1 to 2 weeks earlier when treated with ethylene, a gas that fruits and vegetables produce during ripening. An ARS researcher adapted the ethylene-treatment method, already used by some foreign bulb producers, to help domestic iris growers maintain their competitive advantage in the world market. Ethylene improves forcing, or precocious flowering, in Ideal and Blue Ribbon irises and will likely work on other varieties. Growers can either expose bulbs to ethylene in a chamber or dip them in a solution of ethephon, a chemical that releases the gas. The treated bulbs flower more reliably and produce well-formed blooms. And they are not more susceptible to a serious bulb fungus, as researchers had originally feared.

*Horticultural Crops Research, Corvallis, OR  
Robert P. Doss, (503) 757-4544*

## **Crop Production and Protection**

Certain proteins discovered in leaves of citrus-blighted trees aren't present in healthy trees. Scientists hope to use these proteins as a biological marker to diagnose this disease early. Citrus blight—the number one problem of the citrus industry—can cause whole citrus orchards to be destroyed and immediate areas to be burned to remove dead tissue. Since there's no known cause or cure for citrus blight, there's no prevention method. Early detection could help growers decide about removing infected trees from the orchard.

*U.S. Horticultural Research Lab, Orlando, FL  
Michael G. Bausher, (407) 897-7353*

By first establishing and then killing a stand of Kentucky 31 tall fescue sod underneath peach trees, scientists have found they can increase productivity and also reduce water runoff. The dead sod also provides ground cover that lowers soil temperatures in the summer, prevents rain from eroding the soil and reduces the risk of frost damage when temperatures turn cold. Young peach trees grew faster and yielded more fruit during their first three growing seasons with only normal amounts of fertilizer. Researchers plan next to test this technique on other types of fruit trees.

*Appalachian Fruit Research Station, Kearneysville, WV  
D. Michael Glenn/William V. Welker, (304) 725-3451*

Hail can lower potato yield and alter sugar concentrations, but it does not seriously change potato chip color. Tests with Norchip, the most important chipping potato in the United States, identified for the first time that stress from simulated hail damage modified sugar concentrations in tubers during growth. Yield and dry matter content were also affected, but not the potato qualities that result in light-colored processing chips desired by industry. With the test, the effect of hail damage on market yields can be more accurately assessed. Previous methods estimated only gross yield.

*Potato Research Lab, East Grand Forks, MN  
Paul H. Orr, (218) 773-2473*



With higher intensity light, some potato varieties produce two to four times more leptine, a class of compounds that repel Colorado potato beetles. The response to light intensity provides a new selection test for breeders developing resistant varieties. The beetle pest is the chief factor limiting potato production in the Northeast. It has developed resistance to most of the insecticides used to control it. Potato lines with little or no natural levels of leptines did not respond to the higher intensity light. Leptine occurs only in potato leaves.

*Vegetable Lab, Beltsville, MD*  
*Kenneth L. Deahl, (301) 344-2216*

**Breeding Norway maples** that are resistant to *Verticillium* wilt may be closer to reality. Scientists have identified two varieties, Jade Green and Parkway, that have some tolerance to the fungus that causes the disease. The Norway maple, one of the five most popular shade and street trees in the United States, is often damaged or killed by *Verticillium* wilt. There is currently no treatment for the problem. The amount of variation in wilt tolerance found among 13 tested varieties encourages scientists to believe a completely resistant Norway maple may be possible.

*U.S. National Arboretum, Washington, DC*  
*Alden M. Townsend, (202) 475-4824*

**Good news for plant breeders** and hybrid seed producers, who now have to use hand labor to block certain plants from pollinating themselves: Scientists have pinpointed pieces of plant genetic material—called “promoters”—that might be recruited to “turn on” or “turn off” pollen-killing genes, without affecting other plant parts. This could give breeders and seed producers a less expensive way to make sure a plant can only be fertilized by other pollen. That pollination would yield hybrid seed, prized for traits lacking in seed from self-pollinated plants. Scientists expect this year’s experiments to reveal whether the strategy to thwart self-pollination works with tomatoes. That could open the door to economical production of hybrid seed not only of tomatoes but also of cotton, soybeans and other crops. The promoters, from tomato’s LAT52 and LAT59 genes, are among the first identified that work almost exclusively in pollen.

*Plant Gene Expression Center, Albany, CA*  
*Sheila M. McCormick, (415) 559-5906*

**Researchers have now measured the protection that endophytes** can provide to perennial ryegrass, a popular lawn grass, against the hairy chinch bug. Endophytes are fungi that live harmlessly within plants. They have long been associated with insect resistance, increased vigor and drought tolerance, but this was the first direct evidence of resistance to the hairy chinch bug. The endophyte produces alkaloid compounds that are toxic to or repel a number of grass-feeding insects including the hairy chinch bug and the bluegrass webworm. When hairy chinch bug nymphs fed on test plots of 14 perennial ryegrass varieties, plots with more than 50 percent of the grass infected by the endophyte scored best for appearance and least for insect damage. In tests where adult hairy chinch bugs had no other choice but to live off endophyte-infected ryegrass, only 4 percent survived compared to 93 percent on uninfected ryegrass. Chemical treatments against these lawn destroyers are expensive and may harm beneficial insects. Several endophyte-infected perennial ryegrasses are already on the market or are being evaluated in field trials for insect resistance.

*Germplasm Quality and Enhancement Lab,*  
*Beltsville, MD*  
*Roger H. Ratcliffe, (301) 344-2392*



## Animal Production and Protection

Outbreaks of a fatal disease in U.S. horses that ate moldy corn prompted ARS researchers to check feed samples. They found toxins called fumonisins, recently identified in South Africa and shown to cause the disease equine leucoencephalomalacia (ELEM). Farmers call it "moldy corn poisoning." Not yet proven to cause disease in other farm animals, the toxins are a suspected cause of lung edema (or fluid buildup) in pigs. The fumonisin toxin is made by *Fusarium moniliforme* fungi in moldy corn and corn screenings—a low-quality corn product used in feeds. A major obstacle to finding the cause of the horse deaths was overcome when an ARS scientist developed ways to detect, isolate and measure the fumonisin toxins. Now the scientist is producing small quantities of the purified toxin to be used as the known standard amount to compare with unknown toxic levels in feed. The standard will be used by state and private diagnostic labs and veterinarians to check fumonisin levels in feed.

*Bioactive Constituents Research,  
Northern Regional Research Center, Peoria, IL  
Ronald D. Plattner, (309) 685-4011, Ext. 241*

The risk of mastitis—inflammation of the udder—in dairy cows could be reduced by giving them a natural protein. Tests show that the protein could help cows resist infections around calving time—when they are most susceptible. Cows already make the protein—cytokine G-CSF—in skin and other body cells. It stimulates bone marrow to produce white blood cells to fight infections. Researchers injected 10 dairy cows with the protein daily 2 weeks before through 10 days after calving. The extra protein helped these cows make 10 to 15 times more white blood cells than a control group. In future studies, researchers will test other cytokines and challenge cows' immune systems with bacteria that cause mastitis.

*National Animal Disease Center, Ames, IA  
Marcus E. Kehrli, Jr., (515) 239-8462*

Calves may need booster shots because of a stomach worm that reduces the effectiveness of vaccinations against ailments such as brucellosis and blackleg. *Ostertagia ostertagi*, the medium brown stomach worm, is the most common economically important gastrointestinal parasite of cattle in the world's temperate regions. Researchers have found that in addition to interfering with calves' digestive processes, the worm produces a substance that interferes with the animal's immune system. In experiments, calves were infected with *Ostertagia* and then vaccinated. While the parasites impaired the immunity derived from these initial vaccinations, researchers found follow-up booster shots restored it. If calves that are continually exposed to

*Ostertagia* are immunized against any disease, booster shots may be necessary to protect them. Studies are under way to more accurately identify the immunosuppressant produced by the worms and develop a vaccination against it.

*Animal Parasite Research, Auburn, AL  
Phillip H. Klesius, (205) 887-3741*

Why do baby pigs get sick and sometimes die from diarrhea caused by a common bacterium, while pigs more than 3 weeks old are resistant? An ARS scientist found a reason in a substance in the mucus of the small intestines of the older pigs. The substance may coat toxin-producing *Escherichia coli* bacteria, making them incapable of sticking to the intestinal wall. Bacteria are washed away before they cause disease. The next step is to isolate the substance and further describe its action. If further developed for commercial use, the substance or something similar may be fed to baby pigs to help them resist the bacteria. Diarrhea caused by these bacteria costs pork producers about \$85 million annually in extra feed and maintenance costs. Information gained from studying pigs could help medical researchers develop new strategies to prevent or treat diarrhea caused by other *E. coli* bacteria in children and travelers.

*National Animal Disease Center, Ames, IA  
Evelyn A. Dean, (515) 239-8376*

Sheep embryos can be kept alive and developing outside the mother, using tissue culture cells as "wet nurses." It's a new genetic technique that could mean farmers would have a so-called supermarket to shop for the type of livestock they need. The technique, called coculture of embryos, was developed for livestock by ARS genetic engineers. New embryos are placed in cultures of cells from a sheep's oviduct—the tube which the developing egg goes through on the way to the uterus. Scientists speculate that certain nutrients from the cultured cells keep the embryos alive and developing. So far, the scientists have had a 30 percent success rate of implanting embryos, cultured for 3 days, in surrogate ewes. Eventually, the technique could lead to stocks of culture cells with nuclei containing genes with desired traits. These would be the source of new genes to be transferred to developing embryos. Tests of coculturing cattle embryos are underway.

*Reproduction Lab, Beltsville, MD  
Caird E. Rexroad, (301) 344-2534*

New probes that seek out and bind to the proteins or genetic material (DNA) of a dangerous tickborne microorganism, *Babesia*, are being developed to help ranchers and veterinarians accurately detect bovine babesiosis, or cattle tick fever. Improved tests to diagnose each of

the four *Babesia* species that infect cattle worldwide are needed because today's tests can't detect low-level infections in the blood of cattle and in ticks. ARS and Washington State University scientists used biotechnological methods to construct several protein-seeking probes, called monoclonal antibodies. They have also devised probes that can scout out *Babesia* DNA. Both methods have potential for future diagnostic kits. Even though there hasn't been a major outbreak of bovine babesiosis in the continental United States since the 1940's, it remains a concern here because *Babesia*-carrying ticks occur in Mexico and the Caribbean. (PATENT)

*Animal Disease Research, Pullman, WA*  
Willard L. Goff, (509) 335-6029

Bluetongue virus infections that strike livestock are easier to detect in the lab if blood samples from suspect animals are centrifuged. The centrifuge—basically a sealed bowl that spins at high speed—exerts a force 200 times greater than gravity on an animal's blood and cell cultures. This causes 10 to 20 times more reaction in a test that determines the health status of cattle, sheep and other ruminants and better ensures that the hard-to-find virus is identified. The scientist got the centrifuge idea from a human medical test that enhances detection of a sexually transmitted herpes virus. The presence of bluetongue virus in U.S. livestock has resulted in international barriers to our exports, perhaps costing as much as \$125 million in lost cattle sales each year.

*Arthropod-Borne Animal Diseases Research Lab,  
Laramie, WY*  
James D. Mecham, (307) 721-0309

Home on the range is where horn flies bite cattle and suck their blood, costing producers millions of dollars in losses each year. Making matters worse, the flies are becoming resistant to pyrethroids, the most widely used class of insecticide, in all major U.S. cattle-producing areas—including Hawaii—and parts of Canada. In response, experts from ARS, universities, and industry have issued a set of flexible strategies to hold the line against resistant flies. Their recommendations include switching to other classes of insecticide, using a delivery method different from ear tags or delaying treatment. If producers see hundreds of flies per animal within days or weeks after applying the recommended amount of insecticide, it's a sign the flies have become resistant. Horn fly season begins in some areas as early as mid-March and lasts until the first frost.

*U.S. Livestock Insects Research Lab, Kerrville, TX*  
Sidney E. Kunz, (512) 257-3566

## Insect and Weed Research

Allergy to cockroaches is now being recognized as a serious threat to human health. An estimated 10 to 15 million people in the United States are allergic to cockroaches. Reactions range from runny nose and skin irritation to difficulty breathing and in a few cases, even death. For asthmatics with cockroach sensitivity, exposure to the insects can mean an asthma attack. An ARS expert on cockroaches is coordinating new research to counteract allergies caused by cockroaches. Working with an architect and an immunologist, the ARS entomologist is determining how home construction increases cockroach numbers and hence the amount of allergen in the air. ARS is also supplying cockroaches to doctors, who will separate the insects' proteins and test extracts on sensitive volunteers. Then, when diagnosing cockroach-sensitive patients, doctors will know exactly which of the 50 proteins actually causes allergy and can treat patients for just those sensitivities.

*Insects Affecting Man and Animals Research Lab,  
Gainesville, FL*  
Richard J. Brenner, (904) 374-5937  
*Children's Hospital, Department of Pediatrics,  
Little Rock, AR*  
Rick Helm, (501) 370-3572

People don't recognize the health threat from cockroach allergy, according to surveys in Gainesville, Florida, and the Dominican Republic. ARS and University of Florida scientists questioned residents about their attitudes and behaviors toward cockroach infestation. They found that people know how to reduce cockroach numbers in their homes—for example, by keeping food off countertops and storing trash outside the home. However, they don't always do these things because they don't realize how important it could be to their health. Working with a public education specialist with the University of South Carolina, the researchers hope to teach people that reducing cockroach numbers is not just a matter of aesthetics.

*Insects Affecting Man and Animals Research Lab,  
Gainesville, FL*  
Richard J. Brenner, (904) 374-5937



Honey bees that resist the parasitic *Varroa jacobsoni* mite have been brought from Yugoslavia in a 5-year joint study between ARS and the PKB Institute Agroekonomik in Belgrade. After a 6-month quarantine in the United States, the bees were sent to an ARS lab where scientists will study them to see how the honey bees resist mite attack. They will pass the findings on to bee breeders so they can produce resistant bees to sell to beekeepers. The Varroa mite, which can kill all the bees in a colony within 2 to 3 years, has spread to 24 states and Puerto Rico since its discovery in the United States in 1987.

*Honey Bee Breeding, Genetics and Physiology*  
Research Lab, Baton Rouge, LA  
Thomas E. Rinderer, (504) 766-6064

Sunlight may act as a "green light" for nematodes to go searching for a grasshopper to gobble up. Grasshoppers are a serious crop pest, causing losses of about \$400 million annually. Beneficial nematodes are being considered as a natural weapon against some of them. In lab tests, *Agamermis* and *Hexamermis* nematodes were placed in water agar, and light was shone nearly parallel to the agar surface. Within 15 seconds, the nematodes aligned themselves parallel to each other and moved forward in a straight line perpendicular to the direction of the light. When the dish containing the nematodes was rotated 90 degrees, the nematodes rapidly realigned themselves. The nematodes respond best to light with wavelengths of 400 to 500 nanometers. (Visible light ranges from 400 to 700 nanometers.) This behavioral response to light, called transverse phototaxis, may serve to drive young *Agamermis* and *Hexamermis* nematodes up sunlit grass stems to where grasshopper nymphs might be resting. The nematodes penetrate the bodies of the grasshoppers, live and grow in the insect's blood cavity and eventually emerge, destroying the grasshopper in the process.

*Cotton Pathology Research, College Station, TX*  
Arlin F. Robinson, (409) 260-9233

Shuttle launch pads at Kennedy Space Center in Florida have become a lover's lane for paper wasps. ARS scientists are helping the National Aeronautics and Space Administration (NASA) break up the love connection. Every fall and winter, swarms of paper wasps fly to the tops of the launch pads to mate and overwinter. NASA officials, fearing for the safety of employees and sensitive equipment, asked ARS to help find a control method. So far, scientists have determined that males and females both release sex scents, called pheromones, to attract each other. In wind tunnel tests, females flew against a current toward extracts of the male scent as if it were a live male. Next, the scientists will reproduce the male scents to lure females into traps.

*Insect Attractants, Behavior and Basic Biology*  
Research Lab, Gainesville, FL  
Peter J. Landolt, (904) 374-5756

Odors found in all green plants, combined with insect attractants called pheromones, make a double-whammy lure for three major insect pests. Compared to traps containing only a pheromone scent, other traps with the combination lure were at least 50 percent more attractive to the boll weevil, Mediterranean fruit fly and smaller European elm bark beetle, a carrier of Dutch elm disease. Including plant odors in lures may help growers of cotton, small fruits and other crops get a better handle on these pests. Researchers suspect the odor-pheromone blend sends a stronger message to insects' nerve cells than either substance alone. Preliminary tests also found enhanced response to similar blends by several species of moth, including codling moth and corn earworm. Further tests are planned to check new baits against Southern pine bark beetle and other insects.

*Boll Weevil Research, Starkville, MS*  
J.C. Dickens, (601) 323-2230  
*Commodity Treatment, Handling and Distribution*  
Research, Hilo, HI  
Eric B. Jang, (808) 959-9138  
*Plant Protection Research, Northern Regional*  
Research Center, Albany, CA  
Douglas M. Light, (415) 559-5844

A weed known as the paperbark tree threatens Everglades National Park in Florida. Two insects from Australia are being studied by scientists searching for natural controls to fight the exotic weed. Also known as U.S. Melaleuca, the paperbark tree threatens to choke out native vegetation, potentially endangering many species of the park's wildlife. A weevil, *Oxyops vitiosa*, attacks young foliage, especially paperbark saplings, by eating its leaves. The sawfly *Lophyrotoma zonalis* not only eats the paperbark leaves, but its larvae penetrate the bark. This could create openings for a tree-killing fungus now being studied by University of Florida scientists working with those from ARS. Arrangements are being made to import one of these two insects late this year to test them under tightly controlled conditions in a quarantine lab.

*Aquatic Weed Control Research, Fort Lauderdale, FL*  
Ted Center, (305) 475-0541



A weed called field sandbur can be controlled efficiently for the first time in corn fields. Just one ounce per acre of a new herbicide, nicosulfuron, eliminated up to 85 percent of the field sandburs without harming corn. Similar control is possible with other herbicides, but up to 5 pounds per acre are needed. Nicosulfuron also kills a less damaging weed, redroot pigweed. This information will help the manufacturer register the new herbicide with the U.S. Environmental Protection Agency for onfarm use. Sandbur, found from Wisconsin to Colorado and the Dakotas to Texas, reduces corn yields up to 35 percent in severe infestations by robbing valuable soil moisture and nutrients. Its spiny seed spikelets, designed by nature to aid in seed dispersal, are a major inconvenience because they cling like Velcro to farmworkers, pets and wildlife.

*Central Great Plains Research Station, Akron, CO*  
*Randy L. Anderson, (303) 345-2259*

Steinernematid nematodes may be the biocontrol weapon to help the \$500-million-a-year mushroom industry fight a fly problem without resorting to insecticides. The tiny mushroom flies cut growers' profits because they lay their eggs in the compost, and then the hatched larvae eat the young mushrooms. They breed so quickly that their increasing population usually requires growers to use insecticides to prevent crop losses. In preliminary lab experiments, up to 85 percent of the mushroom flies were controlled by adding 600 Steinernematids per square centimeter of compost (about 4,000 per square inch). The nematodes would not be found on the mushrooms themselves, only in the bedding, so consumers wouldn't have to worry about them. Steinernematids are already commercially available; one company sells them for 10 to 20 cents per million. More tests are planned to refine application rates and intervals in hopes of improving the control rate.

*Nematology Lab, Beltsville, MD*  
*William Nickle, (301) 344-3064*

Commercially available 9-gallon paper-mache flower pots are proving to be the cheapest and best traps for monitoring the northward migration of Africanized bees through Mexico. Researchers who designed the traps say that each pot, plus labor for minor modifications, costs \$6 to \$7. That's about one-third the cost of commercial beehive traps. The traps are hung on tree branches about 10 feet above ground. Migrating bees, attracted by the traps' pheromone lure, readily take up residence in these new homes. That makes it easy for officials to locate these new swarms and determine if they are domestic or Africanized bees. Scientists say the traps could also be part of control programs when the bees cross the Mexican border.

*Carl Hayden Bee Research Center, Tucson, AZ*  
*Justin O. Schmidt, (602) 670-6380*

## Soil, Water and Air

If soybeans are a good indicator, rising carbon dioxide levels could counteract the Earth's ozone pollution, for a net gain in crop yields. When car exhaust and industrial pollutants are released into the atmosphere, they form ozone and smog. Some consider ozone to be a worse threat to plants than acid rain. Last summer, experiments with soybeans in open-top field chambers showed that increasing carbon dioxide levels to 400 parts per million (ppm) negated current ambient ozone's harmful effects on crop yields. When ambient ozone levels were doubled, the carbon dioxide concentration had to be increased to 500 ppm to negate ozone damage. Atmospheric carbon dioxide concentrations have increased from about 290 ppm in the late 1800's to current levels of 350 ppm. The concentrations are increasing by about 1 percent annually. Scientists are investigating repair mechanisms in soybeans and other plants by which one stress caused by atmospheric pollutants such as ozone can be compensated for by other atmospheric components like carbon dioxide. This summer they are repeating their experiment and, beginning in October, the research will be expanded to include grain crops such as wheat.

*Climate Stress Lab, Beltsville, MD*  
*Edward H. Lee, (301) 344-4528*

Wheat growers in the United States can now avoid a costly wait before deciding whether to replant after a heavy rainstorm. Wheat yields can be cut in half by rains that bury many seeds or tiny sprouts. Farmers then usually wait to see how many seedlings will emerge and survive. They may need to replant. But replanting too late means spring wheats could suffer yield losses from excessive summer heat while winter wheats could suffer winter kill. To prevent the costly delay, scientists measured wheat losses caused by varying rainfall with given soil types, tillage practices and surface residue. With this published information, farmers can decide right after the storm whether replanting is necessary.

*Central Great Plains Research Station, Akron, CO*  
*Steven E. Hinkle, (303) 345-2259*

## Scientific Information Systems

A computer program popular for budgeting and other financial chores now helps scientists rank the most important natural aroma chemicals affecting flavor of foods such as tomatoes and nectarines. Researchers claim that aroma is the key to flavor. Thus, fruit and vegetable breeders, packers and processors could use the new ratings to ensure that their products have high-quality flavor. When linked to a gas chromatograph—a standard lab instrument that separates a flavor compound into component chemicals—the computer program speedily performs calculations scientists need to identify and measure each chemical. That's important, because even a modest sampling of the food can require thousands of individual calculations. The program meshes these results with those logged from a "sensory panel"—volunteers who sniff aroma chemicals and assess their contribution to overall flavor. The resulting list of the top dozen or so flavor chemicals in the food is a useful, thoroughly researched target for top quality.

*Food Quality Research, Western Regional Research Center, Albany, CA*

*Donald J. Stern, (415) 559-5668*

**Do the nutrients we eat or neglect affect how our brains function?** Answers to this question may be forthcoming from a new computer software package that makes it easier and less costly to assess the psychological consequences of dietary studies. Called the Cognition-Psychomotor Assessment System (CPAS), the software automates both the administration and scoring of more than 20 psychological tasks. These include attention, perception, learning, memory and problem-solving processes as well as sensory-motor and spatial skill. It has already helped its ARS developers find evidence that a low-boron intake slows people's reaction times in certain tasks. Designed to run on any Apple II computer, CPAS is menu-driven and can be used by novice and expert alike.

*Grand Forks Human Nutrition Research Center, Grand Forks, ND*

*James G. Penland, (701) 795-8471*

If global warming occurs, what will its effect be on water supplies in western states? A computer simulation of the Rio Grande basin in Colorado showed that, for example, an increase of 3 degrees C and a 25 percent loss in winter snow accumulation due to a warmer climate could result in a 30 percent decrease in total seasonal runoff. The model predicts that such climate changes could result in higher-than-normal early spring streamflow, but a greater-than-normal decrease in June and July flow. This could mean bad news for western farmers. Their need for irrigation water is heaviest during these two months. If such a decrease were to occur on many western basins, it could seriously aggravate the already existing problem of too little water. ARS hydrologists, in cooperation with University of Maryland researchers, are doing the computer modeling to help develop ways to combat these losses in streamflow.

*Hydrology Lab, Beltsville, MD*

*Albert Rango, (301) 344-3490*



## Human Nutrition

**Cholesterol-conscious consumers could soon enjoy an oat fiber product** that gives low-fat, low-calorie, cholesterol-fighting alternatives to ice cream, bakery goods, yogurt and other prepared foods. The product, dubbed oatrim, replaces most of the saturated fat in these foods without affecting taste, texture or appearance. Thirteen food companies have expressed an interest in oatrim, a carbohydrate fiber made with natural enzymes. It contains beta-glucan, an active component in lowering cholesterol. Tests with 10-day-old chicks at Montana State University showed an oatrim diet lowered total blood cholesterol 17.8 percent and low-density lipoproteins, the "bad" cholesterol, 47.4 percent. High-density lipoproteins, "good" cholesterol, were elevated 17.7 percent. More tests are planned to widen the range of foods using oatrim. (PATENT)

*Biopolymer Research, Northern Regional  
Research Center, Peoria, IL  
George E. Inglett, (309) 685-4011*

**Frail, elderly men and women**, even those who use canes or walkers, can improve their mobility and reduce the chance of falling with a regular program of strength training. Nine residents of a nursing home, between 87 and 96 years old, volunteered to work their quadriceps—the large muscles on the front of the thigh—three times a week at 80 percent of the maximum weight they could lift. By the end of the 8-week study, the group averaged 174 percent increase in strength and 9 percent increase in muscle size. What's more, two of them stopped using their canes while another could rise from a chair without having to push off the arms. All had the typical ailments of aging people, including coronary artery disease and hypertension. But the exercise did not put extra strain on their cardiovascular systems: Blood pressure and pulse varied little during the sessions. The training has to be continuous for the benefits to last, however. The group lost a third of their muscle strength within 4 weeks after the study ended. A more comprehensive study with 100 volunteers is now in progress.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Maria Fiaterone, (617) 556-3080*

**Older people embarking on an exercise program** need to take it slow and easy. To gauge the effect of rigorous exercise on underused muscles, five sedentary men between 59 and 63 years spent 45 minutes on an exercise cycle adapted to make the front thigh muscles, or quadriceps, resist force while lengthening. This lengthening against force—which occurs in most types of exercise—is responsible for muscle damage and its accompanying soreness.

Microscopic examination of muscle tissue from the men's quadriceps showed damage to nearly 50 percent of the fibers. In young men, similar exercise damaged only about 5 percent of muscle fibers. The findings are not an excuse for older people to avoid beginning an exercise program. They're just a caution to begin slowly and gradually increase the intensity as muscles get used to the new activity.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Roger A. Fielding, (617) 556-3077*

**The typical American mother who nurses** gets more than enough protein for herself and her baby. But new findings suggest she pays a hidden "metabolic tax." That could mean the Recommended Dietary Allowance for protein is set too low for nursing mothers. In studies, nursing mothers retained far less protein even though they consumed 50 percent more calories than non-nursing mothers. This was surprising because calories help hold on to protein. Further studies will examine why only a fraction of the lower protein that is retained is accounted for in the milk.

*Children's Nutrition Research Center, Houston, TX  
Dr. Kathleen Motil, (713) 798-7000*

**People who test low for vitamin B6** may actually have a functional deficiency in vitamin B2 (riboflavin) triggered by certain medications. Recent findings, while preliminary, suggest that some medications for depression may be competing with B2, which is needed to convert B6 into its active form. Six elderly, depressed patients tested deficient in vitamin B6 with a standard enzyme function assay done on red blood cell contents. But when researchers added a form of vitamin B2 to the cell contents, enzyme function tested normal in all 6. By contrast, enzyme function improved in only one of the six healthy control subjects after B2 was added to the cell contents. Medications like the phenothiazines and tricyclic antidepressants look enough like B2 that cellular enzymes may be mistaking them for the real thing, causing a functional rather than a real deficiency in the vitamin.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Frank D. Morrow, (617) 556-3166*

**Levels of selenium, a nutrient that keeps your heart healthy**, can now be estimated faster in nutrition and medical research. ARS scientists have shown that an automated chemical analyzer, the same kind medical labs use for routine blood tests, can indirectly measure the mineral from a small sample of blood. The assay tracks the action of glutathione peroxidase, an enzyme that both contains and depends on selenium. Results are just as



accurate as an earlier glutathione peroxidase assay, which is done tediously by hand and may take up to five times longer. Glutathione peroxidase assays are easier than a third option—directly measuring the nutrient using a lengthy process requiring special equipment and hazardous chemicals. Good sources of selenium are organ meats like liver and kidneys, other meats, seafood, grains, and dairy foods.

*Western Human Nutrition Research Center,  
San Francisco, CA  
W. Chris Hawkes, (415) 556-0131*

Even a marginal copper deficiency can compromise the immune system. Earlier studies showed that a severe deficiency of this essential trace element increased the incidence of infectious diseases in humans and animals. A new study with rats showed that the ability of two types of white blood cells—neutrophils and macrophages—to fight infection was dramatically reduced when the animals were fed only 50 to 60 percent of the recommended amount of copper. The findings are significant, since many Americans consume only about half the copper considered adequate. When fed a marginal-copper diet, the rats' ability to overcome live yeasts and perform other germicidal functions decreased by 25 to 40 percent. Further, the amount of copper stored in these disease-fighting white blood cells was cut in half, as was the activity of a copper-containing enzyme. Additional studies are planned to learn whether testing of these white blood cells could be used to measure copper levels in the body. Oysters, liver, cocoa, blackstrap molasses and black pepper are rich sources of the mineral; lobster, nuts and seeds and whole wheat bran are good sources.

*Vitamin and Mineral Lab, Beltsville Human Nutrition  
Research Center, Beltsville, MD  
Mark L. Failla, (310) 344-2148*

Nailing down a suspected link between low copper intake and coronary heart disease has proven elusive for researchers. The latest findings indicate people's genetic makeup, as well as their sex and the types of proteins and carbohydrates in their diets, may influence how they respond to short periods of inadequate copper. When 10 men got less than half the suggested copper intake for 6 weeks, four of them responded with a significant increase in cholesterol—at least 7.5 percent—primarily in the undesirable LDL cholesterol. Also, their blood platelets—the “quarterbacks” of clotting—got larger and stuck together more readily, which is thought to contribute to the blockage of arteries. But the other six men didn't show these symptoms. All 10 of the men, however, showed early signs of copper deficiency based on a very sensitive test. Despite the inconsistencies, many of the changes indicate that a long period of

copper depletion could be harmful. An estimated 35 percent of Americans get only 1 mg/day or less—compared to the suggested 1.5 mg/day.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
David Milne/Forrest H. Nielsen, (701) 795-8424/8456*

Copper deficiency increasingly appears to suppress the body's own antioxidants—leaving tissues more vulnerable to their own toxic byproducts and to environmental pollutants such as ozone. At least three antioxidants found in animals and humans depend on copper to function properly. In earlier studies with copper-deficient rats, adding antioxidants to their food partially protected the animals against the heart damage and anemia typical in severe deficiency. New studies done cooperatively with researchers at the V.A. Medical Center in Tucson show that copper-deficient rats exhale significantly more ethane. This suggests that more of their fats are being oxidized by toxic metabolic byproducts that copper-dependent antioxidants would normally inactivate. Finally, a study with researchers at the University of North Dakota Medical School found more lung damage in copper-deficient rats than in a control group when both were subjected to oxygen under high pressure.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Jack T. Saari, (701) 795-8499  
Veterans Administration Medical Center, Tucson, AZ  
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University of North Dakota Medical School,  
Grand Forks, ND  
Thomas K. Akers, (701) 777-3923*

Pharmaceutical companies and labs could be overlooking or misinterpreting some of the metabolic changes they see when testing new medications and compounds. While developing a rapid technique for analyzing biological fluids, ARS researchers collaborating with University of London colleagues found that metabolic products in test animals' urine can vary dramatically depending on their age or diet. This means that metabolites attributed to the compounds being tested may really be due to other factors. The new analytical technique, based on nuclear magnetic resonance (NMR), offers a number of advantages over current ones. It allows chemists to see the broad spectrum of metabolites so they don't miss products they weren't looking for. It's also more convenient and accurate. The NMR technique is not good for detecting minute amounts of compounds, however.

*Vitamin & Mineral Lab, Beltsville Human Nutrition  
Research Center, Beltsville, MD  
Orville A. Levander, (301) 344-2504  
University of London, London, England  
Peter J. Sadler, (011441) 380-7480*

# Quarterly Report of Selected Research Projects

United States  
Department of  
Agriculture

 Agricultural  
Research  
Service

July 1 to September 30, 1990

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## New and Improved Products

A new potato variety for chips and another for baking produce more superior-quality potatoes than other common varieties, according to trials in four western states. ARS scientists bred and tested Gemchip, which yielded 30 percent more U.S. No. 1 grade potatoes than the popular Norchip variety. Because Gemchip potatoes have a higher solid content, they absorb less oil during frying—a bonus for consumers and processors, because oil is both caloric and costly. The baking potato, Frontier Russet, also makes good french fries straight from the field or after a few months of storage at 45 degrees F. Frontier Russet has been grown commercially for 3 years, after its selection and early testing by ARS and agricultural experiment station cooperators. Gemchip was given high marks for chip quality by several chip manufacturers.

*Small Grains and Potato Germplasm Research,  
Aberdeen, ID*

*Joseph J. Pavek, (208) 397-4181*

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

A new black seedless grape and a bright red seedless—both products of ARS research—could be on the market in 3 to 5 years. Every major grape nursery in California—the leading producer of fresh-market grapes—has asked for cuttings of the new grapes. Fantasy Seedless, a black grape for mid-summer, is sweet and firm, with naturally large berries. That's good news for growers, who won't need to boost berry size by applying a growth regulator or by girdling the plants (making an incision around the base of the vine to change the flow of nutrients and force berry growth). Both tactics add to production costs. Crimson Seedless red grapes, for September and October harvest, are medium to large, with light yellow flesh. This new grape variety may someday replace Emperor, a red grape that ripens about the same time, but contains seeds.

*Horticultural Crops Research Lab, Fresno, CA*

*David W. Ramming/Ronald E. Tarailo, (209) 453-3061*

Ski clothing and other sportswear made from fabrics that respond to changes in temperature will soon be marketed, now that a small Iowa firm and one of Japan's largest companies have received exclusive licenses to develop these and other products. Using a process developed by ARS scientists, the thermal fabrics are treated with a class of chemicals called polyethylene glycols or with other compounds known as plastic crystals. In lab tests, the fabric absorbed and stored heat when the temperature rose and released it when the temperature dropped. How much heat the treated material will store and release depends on the kind of fabric, the chemical applied and the amount used. NeutraTherm, Inc. of Des Moines will develop ski clothing, other sportswear and biomedical products. Mitsui & Company of Tokyo will make products—mainly sportswear and biomedical—for sale only in Japan. Companies in France, Italy and Australia also have applied for licenses to use the patented technology. Several other U.S. and Canadian companies are interested in licensing the technology for various uses—such as in carpets, footwear, automotive interiors and fabrics for agricultural applications. (PATENT)

*Textile Finishing Chemistry Research,  
Southern Regional Research Center, New Orleans, LA  
Tyrone L. Vigo, (504) 286-4487*

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**An anti-cancer drug called taxol** can be made by growing the drug-producing cells in tissue culture. ARS researchers took the cells from the Pacific yew, an evergreen tree that grows in the Pacific Northwest, and chemically stimulated the cells to reproduce in tissue culture. This could replace the current practice of harvesting the Pacific yew tree for its drug-producing bark. Up to 20,000 pounds of bark—2,000 to 4,000 trees—are needed to produce 2.2 pounds (1 kilogram) of the drug. The trees do not grow over a large geographic area and take nearly 50 years to reach harvestable size. Taxol is too complicated a chemical compound to commercially synthesize at this time. A company is being sought for a research and development agreement to develop a way to scale up the tissue culture technique for commercial use. (PATENT)

*Microbial/Plant Technology Research, New Orleans, LA  
Donna Gibson, (504) 286-4430*

**Corn kernel cells are successfully pinch-hitting** for their wheat counterparts in high-tech experiments to improve wheat. Wheat kernel cells that produce flour protein can't yet be raised in lab flasks, but the counterpart corn kernel cells can. So genetic engineers are relying on the corn cells to test promoters—segments of wheat genes that act like an on-off switch and start, stop or amplify gene activity. Powerful promoters are in demand because they're ideal for splicing onto genes to genetically engineer tomorrow's wheats, making wheats more nutritious, for example. Biotechnologists take wheat's most promising promoters, link them to a marker gene that prompts cells to make a readily measured indicator compound, then insert the newly spliced genes into corn kernel cells. The amount of compound the corn kernel cells make will reveal each promoter's strength. Bonus: Corn cell results are ready in a few days. Other approaches, such as testing wheat's promoters in tobacco plants, take months to years.

*Plant Development-Quality Research,  
Western Regional Research Center, Albany, CA  
Ann E. Blechl/Olin D. Anderson/Frank C. Greene,  
(415) 559-5716  
Department of Agronomy, University of Florida,  
Gainesville, FL  
Gale F. Lorens, (904) 392-1823*

**"Tuning up" crude soybean oil with sound waves** can produce a better salad dressing. The new oil processing method uses ultrasound—very high frequency sound waves—to get rid of gummy impurities. It could replace today's more complicated and costly processing. With the new technique, soybean "crude" is sound-vibrated at 20,000 times per second in a mix of water and citric acid. With all the shaking going on, tiny bubbles continuously form and pop, creating mini-sites of extreme heat where flavor-damaging gum compounds cluster. The gums—fatty acids and phospholipids—are easily spun away with a centrifuge. What's left is a partially processed oil for further refining into a flavorful soy oil. Taste panelists couldn't distinguish the refined oil from the conventionally processed kind.

*Food Quality and Safety,  
Northern Regional Research Center, Peoria, IL  
Timothy L. Mounts, (309) 685-4011, Ext. 555*

**Light energy emitted by fruit** may be measured on processing lines in the future to ensure that fruit wasn't picked too early. If fruit is picked too soon, it won't ripen to proper maturity and quality by the time it reaches the grocery shelf. ARS scientists are studying a system based on the principle of delayed light emission (DLE) as an objective way to measure maturity. Fruit is now classified for maturity by mechanical sorters that account for weight, size and color. DLE, however, is a low intensity light emitted for several seconds or minutes from chlorophyll-containing fruit tissue after exposure to light. As fruits ripen, the chlorophyll content decreases, reducing the amount of light emitted. Changes unseen by the naked eye can be detected with DLE. Scientists are developing a maturity index that includes information on other factors—such as carotene, sugars and firmness—that are known to be related to maturity and can be correlated with a DLE reading.

*Food Quality Evaluation Research, Athens, GA  
William R. Forbus Jr., (404) 546-3131*



**Strawberries may have a new ally**—a bacterium naturally occurring in apple leaves. ARS scientists discovered that the bacterium's weapon, a compound called pyrrolnitrin, destroys microorganisms that cause fruit-rot and other molds on harvested strawberries. As a result, berries have a longer shelf life. Once the berries are dipped in a solution of 250 milligrams per liter of pyrrolnitrin and then stored at room temperature, they will last 5 days before molding. Without the compound, the berries last only 2 days at most. Pyrrolnitrin gave the same amount of rot control as one-tenth the concentration of standard fungicides. Commercial fungicides face increasing restrictions because of a growing concern for environmental safety. Scientists will continue to study how pyrrolnitrin and other naturally produced compounds can further protect crops as a replacement for fungicides.

*Appalachian Fruit Research Station, Kearneysville, WV  
Fumiomi Takeda/Wojciech Janisiewicz, (304) 725-3451*

**Current methods of processing frankfurters** prevents growth of the food-poisoning bacterium *Listeria*, ARS studies show. Heating raw beef or pork frankfurters to an internal temperature of 160 degrees F for 70 minutes will adequately control the organism that causes listeriosis. Although different processors use different heating steps to achieve particular qualities, such as texture or flavor, all meet or exceed the 160 degree/70 minute standard. To find minimum processing levels that thwart bacterial growth, researchers blended meat samples with sugar, sodium nitrite and ascorbic acid and stuffed the mixture in cellophane casings. The samples were inoculated with *Listeria* and tested at six different sets of time and temperature. Until now, only milk pasteurization had been analyzed at various levels to determine the rate of *Listeria* destruction. These studies will help establish regulations for preventing *Listeria* contamination in processed frankfurters and other cooked sausages.

*Microbial Food Safety,  
Eastern Regional Research Center, Philadelphia, PA  
Laura L. Zaika, (215) 233-6655*

**Detecting phony flavors**, priced and sold as all-natural products, could be easier now. A new technique easily separates key flavor compounds of apples, pineapples and strawberries into two distinctive forms—one natural and the other a tip-off to synthetic flavorings. Similar analyses might be done by food manufacturers on dozens of fruits that contain the two flavor forms, called enantiomers.

Samples are injected into a special column, lined with molecules called beta-cyclodextrin, that is used in a capillary gas chromatograph. Because enantiomers can differ drastically in aroma, potency and other characteristics, the technique could also be used to ensure products such as perfumes, medicines and lures for insect control contain the desired enantiomer.

*Food Quality Research,  
Western Regional Research Center, Albany, CA  
Gary R. Takeoka, (415) 559-5668*

**Farmers and gardeners may someday draw "designer fungi"** from their arsenal of weapons used to kill insects on corn, cabbage, wheat and other crops. ARS scientists identified a variety of enzymes made by five strains of a common soil fungus. These enzymes dissolve an insect's hard shell and allow the fungus to consume the insect. Scientists hope to manipulate the enzymes to enhance insecticidal fungi. Fungal spores containing the enzymes could be mass-produced and sprayed on crops. Because the enzymes act only on specific target insects, this approach is probably safe for plants, animals, people, beneficial insects and the environment. An added bonus: It's unlikely insects could develop resistance to this type of control. The work is being supported by the Biotechnology Research and Development Corporation, a consortium of companies, universities and ARS' Northern Regional Research Center. The consortium was formed in 1988 to develop new commercial products from research. Commercial development of natural insecticides from this research may be only 2 to 5 years away.

*Microbial Properties Research,  
Northern Regional Research Center, Peoria, IL  
Subhash C. Gupta/Timothy D. Leathers, (309) 685-4011*

**Two newly discovered antibiotics** from a soil fungus have inhibited the growth of staph bacteria. One of the world's leading causes of human infections, *Staphylococcus aureus*, can be treated with antibiotics. But staph has become resistant to most antibiotics and has begun showing resistance to vancomycin, the latest to be used. Recently, an ARS scientist found a pair of antibiotics in a soil fungus that stopped the growth of methicillin-resistant staph bacteria. Any further studies on the pharmaceutical potential of the antibiotics would be done by medical researchers. (PATENT)

*Citrus and Subtropical Products Lab, Winter Haven, FL  
Robert A. Baker, (813) 293-4133*

## **Human Nutrition**

A salmon-rich diet increased levels of a compound that—in high amounts—can lower the risk of heart disease. For 40 days of a 100-day ARS experiment, male volunteers ate salmon entrees for lunch and dinner. Purpose: To provide data for researchers who want to clarify the relation between a fish-rich diet and a lowered risk of heart disease. During the salmon regimen, the volunteers' level of high density lipoprotein 2b (HDL<sub>2b</sub>) increased an average of 10 percent. The lipoprotein is usually not high in men, but is typically elevated in pre-menopausal women, who in turn have less risk of heart disease than men. (HDL is associated with lowering the risk of heart disease). The salmon study finding may be unique, as most earlier experiments with omega-3 fatty acids—the type found in fish—didn't investigate that lipoprotein subfraction.

*Biochemistry Research, Western Human Nutrition  
Research Center, San Francisco, CA  
Gary J. Nelson, (415) 556-0899*

**Middle-age diabetes doesn't happen overnight.** Blood glucose and insulin levels creep ever higher as the hormone loses its effectiveness in metabolizing glucose. Finally, the body may stop producing insulin altogether. A new study indicates that getting enough chromium each day can nip this process in the bud. Seventeen men and women ate diets containing less than 40 percent of the minimum suggested chromium intake. (This reflects the daily intake of about one-fourth of the U.S. population). After adjusting to this diet, the volunteers alternated between 5-week periods when they got a 200-microgram (mcg) supplement—the maximum suggested chromium intake—or a look-alike placebo. The eight volunteers who began the study with slightly elevated glucose and insulin levels had a significant improvement in glucose tolerance with the chromium supplement. But it had no effect on the nine volunteers who started with desirable glucose and insulin levels. The findings suggest that very low chromium intakes may be putting millions of middle-aged Americans on the road to diabetes and that the process could be reversed simply by getting adequate chromium. That's easier said than done, however, because it's hard to get even the minimum suggested intake—50 mcg/day—through foods. Some of the best sources are broccoli, grape juice and cold cereals, especially the brands fortified with vitamins and minerals.

*Vitamin and Mineral Lab, Beltsville Human Nutrition  
Research Center, Beltsville, MD  
Richard Anderson/Marilyn Polansky, (301) 344-2091*

Young women who avoid eating whole grains, vegetables, nuts and seeds may be losing more than iron during menstruation. Plant foods are virtually the only source of the essential element manganese. A 5-1/2-month study of manganese requirements turned up a surprising finding: When the dietary level was sharply reduced, menstrual loss of other minerals increased. The 15 young women in the study lost between 50 and 100 percent more iron, copper, zinc and manganese through their menstrual flow when their manganese intake was reduced to a very marginal 1 milligram (mg) per day. That's because they lost about 50 percent more menstrual fluid while on the low-manganese diet. It's known that high doses of some minerals interfere with the absorption or use of other minerals. This is the first indication that the dietary level of a mineral—and low doses at that—can influence the loss of other minerals. However, a low-manganese intake is likely not the cause of heavy bleeding in most women because intakes are generally much higher than 1 mg/day.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Phyllis E. Johnson, (701) 795-8416*

Older women who get less than half the recommended amount of calcium can benefit greatly by increasing their intake, according to a 2-year study of 361 women past menopause. In those women with the lowest normal intakes—less than 400 mg daily—an extra 500 mg of calcium daily cut bone loss to less than 1 percent in the hip and spine over the 2 years, but only if the women were 6 or more years past menopause. It was not effective in the women who had stopped menstruating within 5 years of the study's beginning. The loss of estrogen, which prompts rapid bone loss, apparently overrides the benefits of getting adequate calcium for several years. Extra calcium also didn't slow bone loss in those women who normally consumed between 400 and 650 mg of calcium daily. The average calcium intake from food sources for U.S. women 50 years and older is estimated at 560 to 600 mg/day. That means millions of American women are getting much less than the average from their diet. The best sources of calcium are food sources, particularly low-fat milk, yogurt and cheeses.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Bess Dawson-Hughes, (617) 556-3064*



**Calcium absorption in older women drops in late winter and rises in late summer, along with seasonal fluctuations of vitamin D hormone.** The hormone—a special form of the vitamin—helps regulate calcium absorption. When sunlight is too sparse to promote vitamin D manufacture in the skin, people must get more from food. Researchers earlier found that blood levels of the hormone dropped in 333 postmenopausal women after the sun-starved days of winter and rose at the end of summer. This suggests that the current Recommended Dietary Allowance of vitamin D is too low to maintain bone calcium year round. That finding was strengthened when 31 of these women were tested for calcium absorption during the two seasons. Results showed that the level of circulating vitamin D hormone has a direct measurable effect on calcium absorption.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Elizabeth Krall, (617) 556-3074*

**To what extent does diet influence risk of developing some common cancers?** A technique that measures diet-related risk of colon and possibly other cancers should give physicians a more solid basis for advising individuals to modify their diet long before disease develops. And it should enable scientists to survey large populations and develop a national map showing risk rates in various geographic areas. ARS scientists adapted a French-developed test to study the effects of changing dietary fat. The test uses a genetically engineered *E. coli* bacteria to measure the amount of DNA breakage, or mutations. This is a necessary step in the transition of cells from a normal to a malignant state, so an increase in mutations increases the risk that cells will turn malignant. When 31 women in a controlled dietary study cut their fat intake in half—from 40 to 20 percent of calories—their stool extracts produced only half as many mutations. And current studies of stool extracts from men are yielding similar results. The technique may also prove to be a good indicator of risk of breast and other cancers because fatty mutagens in the colon can be reabsorbed and deposited in the breast and other fat-containing organs.

*Lipid Nutrition Lab, Beltsville Human Nutrition  
Research Center, Beltsville, MD*  
*Padmanabhan P. Nair, (301) 344-2145*

**A strain of *Lactobacillus acidophilus* bacteria—known as ADH—can reduce the level of carcinogen-producing enzymes in the gastrointestinal (g.i.) tract, researchers are finding.** These unwanted enzymes convert potential carcinogens into substances known to promote cancer in animals. Researchers are attempting to colonize the g.i. tracts of older people with beneficial bacteria in hopes of reducing cancer risk and improving absorption of certain vitamins. In tests, eight older men and women had almost half as many carcinogen-producing enzymes in their stools after they took capsules containing live ADH twice a day for 12 days. Eight other volunteers, who ate yogurt twice a day instead, had a slight but statistically insignificant reduction in these enzymes. Yogurt is currently made with two other types of bacteria but could easily be made with ADH. While there's no hard evidence that these enzymes increase colon cancer in people, scientists believe there's a good chance they do.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Marcos C. Pedrosa, (617) 556-3130*

**Although all newborn infants are severely deficient in vitamin K at birth, only a small percentage of them develop life-threatening bleeding problems.** ARS researchers recently found that 10 percent of newborns have faulty prothrombin—the protein that makes blood clot. And more than 40 percent have nonfunctioning protein C, which retards clotting. Production of both proteins depends on vitamin K. Hospitals routinely give infants vitamin K shots at birth to prevent cerebral hemorrhage. But this doesn't help the fetus before and during delivery, and a few do suffer hemorrhage. ARS and University of Vermont researchers are collaborating to see if supplementing pregnant women with vitamin K will help raise the level of this vitamin in the fetus and correct the faulty production of prothrombin and protein C during gestation.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*James A. Sadowski, (617) 556-3151*

Women being treated for an underactive thyroid could be losing more bone than normal if the hormone dosage is too high. People who secrete excess thyroid hormone are known to have increased risk for osteoporosis. So when researchers conducted a 2-year trial to assess the benefits of calcium supplements for women during and after menopause, they took a special look at the 18 participants being treated with thyroid hormone. Ten of these women were getting more hormone than needed, based on a sensitive new assay of thyroid stimulating hormone (TSH) levels. And they lost bone in the wrist and spine at a significantly faster rate than over 235 "controls" with normal thyroid function. Loss of bone from the hip also tended to be faster in the 10 women. Physicians need to keep close tabs on patients getting synthetic thyroid hormone to prevent unnecessary bone loss.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Bess Dawson-Hughes, (617) 556-3066*

## **Animal Production and Protection**

A few miniature Brahman cattle in Florida may provide clues in solving a baffling cause of human dwarfism. While raising cattle for studies on a possible relationship between an animal's size and reproduction performance, scientists found a few of the Brahmans were born exceptionally small. These animals have five times more growth hormone than found in normal-sized cattle. But, the miniature cattle's levels of another hormone, called insulin-like growth factor-1, were low. Normally, high levels of growth hormone are accompanied by high levels of IGF-1. Low levels of IGF-1 can result in smaller stature because IGF-1 is one of the major hormones regulating growth. High growth hormone and low IGF-1 levels are also found in humans suffering from Laron dwarfism. Studying the disparity between the cattle's growth hormone levels and IGF-1 levels could help medical researchers find a way to alleviate Laron dwarfism.

*Subtropical Agricultural Research, Brooksville, FL  
Andrew C. Hammond, (904) 796-3385*

A rare genetic defect has been identified for the first time in dairy cattle. The defect, called leukocyte adhesion deficiency (LAD), is also seen in human infants. Researchers found that white blood cells in Holstein calves with LAD lack a protein called MAC-1. The protein enables neutrophils—a type of white blood cell—to penetrate blood vessel walls and reach infection sites in the body. Without this defense, the calf's immune system is unable to fight off disease-causing bacteria. Researchers are developing a diagnostic test to identify animals with the defective gene to ensure that two carrier animals are not mated. Each year, animal deaths from infectious diseases cost producers about \$75 million.

*National Animal Disease Center, Ames, IA  
Marcus Kehrli, (515) 239-8462*



An experimental vaccine has been virtually 100 percent effective in protecting young chickens from coccidiosis, an intestinal disease. Administered orally, the vaccine protected approximately 200 chickens from the three most virulent species of microbes that cause chicken coccidiosis. Costs to U.S. poultry farmers reach \$300 million annually for medications and lost weight gain in chickens. Scientists made the vaccine by exposing a preparation of the infective stage of the coccidial parasite to X-rays. No radiation remains in the sterilized parasite, which cannot reproduce but can infect chickens. Apparently, the birds react by producing antibodies and immune cells to fight the infection. When the birds were later exposed to virulent forms of the disease, the same antibodies and immune cells protected them. Lengthy testing is needed before this vaccine is accepted for practical use.

*Protozoan Diseases Lab, Beltsville, MD*

*Mark C. Jenkins, (301) 344-8054*

Feeding grain supplements to cattle on pasture is not an effective substitute for giving them medication to combat internal parasites. That was the finding from a study on whether livestock producers could boost nutrition levels and skip parasite treatments. Some parasite-infected crossbred steers ate a combination of Coastal bermudagrass and grain supplement. Others only grazed the grass. Some of the steers received parasite treatment, while others did not. At the end of 140 days, the treated steers on either diet weighed an average 63 pounds more than their untreated counterparts. Grass measurements showed untreated animals grazed less and left more forage behind because the parasite infection had decreased their appetites.

*Animal Parasite Research, Auburn, AL*

*Daniel E. Snyder, (205) 821-1732*

A disease that has attacked millions of farm-raised minks worldwide appears to be caused by a crown-shaped virus, or coronavirus. The discovery, by ARS researchers, was an offshoot of a study using mink as a model to study scrapie, a serious neurological disease that strikes sheep. Using an electron microscope, the researchers detected coronavirus particles in feces of affected mink. The disease, known as epizootic catarrhal gastroenteritis (ECG), causes temporary anorexia and diarrhea in mink, which can decrease pelt quality and leads to economic losses for mink producers. ECG is highly contagious and mink kittens may die of starvation if their mothers contract the disease while nursing.

*Animal Diseases Research, Pullman, WA*

*John R. Gorham, (509) 335-6029*

## **Crop Production and Protection**

Herbicides released slowly from starch "capsules" might keep weeds from choking vineyards and be safer for the vines and the environment. In lab tests, an encapsulated herbicide that kills barnyardgrass, green foxtail, lambsquarters and other pesky weeds stayed in the top 1/2-inch to 1 inch of soil when water was added to simulate irrigation. Non-encapsulated herbicides leached 5 to 6 inches. If the results hold true in outdoor experiments underway on drip-irrigated plots, encapsulation could help protect groundwater from deep leaching of herbicides—a common hazard in sandy soils. Weed kill also might be enhanced because the compound, when held near the soil surface, is more likely to contact the vulnerable roots of sprouting weed seeds. On the other hand, grapevines—with their deep, well-established roots—would be at less risk. ARS scientists at Peoria, Illinois, developed the encapsulation process; their colleagues at Prosser, Washington, are the first to apply it in vineyards.

*Weeds, Soil and Water Management Research,  
Prosser, WA*

*Rick A. Boydston, (509) 786-3454*

*Plant Polymer Research,*

*Northern Regional Research Center, Peoria, IL*

*Robert E. Wing, (309) 685-4011*

If wheat plants get adequate nitrogen fertilizer, they can better withstand Russian wheat aphids, which now infest 16 states. That's the conclusion of lab tests aimed at reducing yield losses the pest causes without using insecticides. Aphid-infested wheat fertilized with 100 percent of its normal nitrogen component lost 30 percent of the expected yield. But plants that received less nitrogen suffered yield losses of 50 percent or more. Between 1986 and 1989, the aphid cost growers of wheat and other small grains more than \$240 million in yield losses and pesticides.

*Northern Grain Insects Research Lab, Brookings, SD  
Walter E. Riedell, (605) 693-5207*

Corn—one of the most difficult plants to genetically engineer—has yielded to ARS and Monsanto Co. researchers who have succeeded in transferring new genes into the plant. Their work paves the way for introducing valuable new traits, such as resistance to insects or disease, into corn and other monocots such as wheat, oats, barley and rice. Monocots—plants that put forth one leaf from germinating

seed—are far more resistant to gene insertion than dicot plants with two seed leaves, such as tomato. This research is among the first to apply techniques of modern biotechnology to move new genes into corn cells that later produced healthy, fertile plants. In turn, these parent plants passed the new genes to their offspring. Monsanto funded part of the research and provided special lab cultures of corn cells that accepted new genes fired from a “gene gun.”

*Plant Gene Expression Center, Albany, CA*

*Rosalind E. Williams, (415) 559-5908*

*Plant Science Technology, Monsanto Co., St. Louis, MO*

*Robert T. Fraley, (314) 537-6204*

**Super corn varieties of the future may come equipped to resist major diseases.** That’s because of the discovery of a corn gene, *Mdm1*, that controls resistance to the world’s most widespread and damaging corn virus, maize dwarf mosaic virus. The next step is to isolate the gene and place it into corn or other plants for breeding disease-resistant varieties. Researchers have succeeded in mapping *Mdm1*’s location on a specific segment of maize chromosome 6. This is the first report in corn of a chromosomal map position for any gene related to a viral disease resistance.

*Corn and Soybean Research, Wooster, OH*

*Michael D. McMullen, (216) 263-3894*

**Some rice plants can change their sex,** and that could offer seed producers in the United States an affordable way to grow hybrid seed. Farmers want hybrid rice because it yields 15 to 20 percent more than non-hybrids. But today’s cost of producing hybrid seed is so high that virtually none is grown in this country. What’s required are male-sterile rice plants—that is, plants that won’t pollinate themselves. These sex-changing rice plants fit the bill because they shift their sexual orientation when they receive 15 hours of sunlight during a critical period of their growth. Having performed this trick, known as photosensitive male sterility, the plants are ready-made to accept pollen carried by wind from neighboring, fully fertile plants. That pollination produces hybrid seed. ARS scientists hope to provide samples of this seed to breeders later this year. Photosensitive male sterility has been found in rice only once before, by Chinese scientists.

*Mid-South Area, Stoneville, MS*

*J. Neil Rutger, (601) 686-2311*

*Plant Molecular Biology Lab, Beltsville, MD*

*Gideon N. Schaeffer, (301) 344-4342*

**Dough-making characteristics of wheat kernels** may suffer when summer’s heat soars. Wheat that endures daytime temperatures hotter than 95 degrees F will end up with an undesirably low ratio of glutenin to gliadin proteins. The reason: Wheat’s genes for glutenin production begin to slow at 95 degrees and shut down at about 99 degrees. Milder temperatures produce a higher ratio of glutenins to gliadins. That makes for top-quality wheats—the ones that yield strong, stretchy dough for the best breads and rolls. To keep glutenin production going at high temperatures, ARS scientists will try building a new gene so the kernel will crank out gliadin even at 113 degrees. Building the new gene and coaxing wheat to accept it might take as little as 6 months—or as long as 5 years, because wheat typically resists biotechnologists’ best efforts to give it new genes.

*Plant Development Quality Research,*

*Western Regional Research Center, Albany, CA*

*John E. Bernardin/William B. Inwood, (415) 559-5761*

**A crop pest with a wanderlust** is facing a formidable fungal foe from Eastern Europe and South America. Potato leafhoppers pass the winter in the warmer Southern states, then migrate northward in spring to attack more than 200 crops, including potatoes and alfalfa. Farmers have traditionally fought back with chemical insecticides. But now a natural pathogen, *Zoophthora radicans*, may offer a new alternative. It can kill a leafhopper in 3 to 4 days, then spews spores to infect other leafhoppers and infest leaf surfaces where the pests might cross. The fungus can be grown easily in the lab. Researchers field-tested different types of *Z. radicans* from Brazil and Yugoslavia for their ability to survive winters in spots such as New York and Illinois; the fungal strains persevered in New York, but vanished in Illinois. Tests are now underway on various methods of introducing the fungus in fields and making it stick through the changing seasons.

*Plant Protection Research, Ithaca, NY*

*Raymond I. Carruthers/Alan J. Sawyer,*

*(607) 255-2456/2458*



Scientists seeking improved plants often have to measure root size, a laborious, time-consuming task that sometimes ruins the roots. The hardest to measure are those growing in soils with lots of clay—mere washing with water fails to expose the roots. A scientist recently showed that a fairly mild concentration of acetic acid breaks up the clay without harming roots, and works much faster than water. The simple method works equally well in lab and field studies.

*U.S. Salinity Lab, Riverside, CA*

*M.T. Van Genuchten, (714) 369-4814*

A "buddy system" is at work in the soil around Florida citrus trees, protecting them from destructive weevil larvae. Working together are hungry bacteria and three species of tiny worms known as nematodes—*Steinernema feltiae*, *S. glaseri* and *Heterorhabditis heliothidis*. When sprayed into the soil surrounding infested trees, the beneficial nematodes attack weevil larvae that feed on the roots of orange, lime and grapefruit trees. The bacteria—living symbiotically within the nematodes—actually kill the larvae by blood poisoning. In turn, the nematodes feed off the bacteria's by-products. The nematodes only stick around as long as their weevil hosts and—unlike pesticides—don't harm nearby groundwater. Available on the market for about 40 cents a million, the nematodes can wipe out 80 percent of weevil larvae populations. The nematodes also are used against insects that attack artichokes, rice and cranberries.

*Horticultural Research Lab, Orlando, FL*

*William J. Schroeder, (407) 897-7379*

An enzyme that helps tomatoes ripen has been identified by ARS scientists. The discovery may make it possible to genetically engineer tomato plants so production of this ripening enzyme is activated at the proper time to increase shelf life of tomatoes. The enzyme—called beta mannanase—breaks down cell walls inside the tomato, causing the fruit to soften. It is absent when tomatoes are completely green, the scientists found, and increases in concentration as the fruit changes from green to red. If tomatoes are picked before they are completely red, the enzyme continues to function in the picked fruit. Controlling this enzyme also should guard against bacterial infection. Cell walls, if not weakened, could defend against threatening bacteria. Although beta mannanase was known to exist in the seeds of several plants, this is the first time it has been found in fruit tissue.

*Plant Physiology Research, Athens, GA*

*Russell Pressey, (404) 546-3544*

A new carrot called B5280 has a mild, sweet flavor and is three to five times richer in carotene than most carrots.

Carotene is converted by the body into vitamin A. B5280 also resists a serious carrot disease, *Alternaria* leaf blight, which growers typically have fought with chemicals. The new carrot resulted from efforts to find a breeding line for developing countries where people prefer short, stubby carrots and where increased carotene in diets could overcome vitamin A deficiency. B5280 can also be crossbred with other carrot varieties to impart leaf blight resistance to the long, thin hybrid carrots favored in the U.S. fresh market. In international tests, other ARS experimental carrots have received favorable ratings for appearance and eating qualities.

*Vegetable Crops Research, Madison, WI*

*Philipp W. Simon, (608) 262-1248*

Dill, cheyote and goldenberries are potential money-makers for small farmers in the Mississippi Delta region. All three crops, new for the region, can be grown on small acreage with little capital investment. Dill would be used as a flavoring in the local crawfish processing industry. A single processing plant in Baton Rouge uses about 150,000 pounds of fresh dill and 30,000 pounds of dill seed each year. Cultivation techniques are being improved to raise dill with a maximum amount of carvone, the aromatic ingredient that gives dill its characteristic smell. Growing practices also are being developed for cheyote—a white or green pear-shaped relative of the cucumber. Popular in backyard gardens, it also has potential as a commercial crop. Goldenberries, a tomato relative that could be the next kiwi in terms of popularity, also have been found to be a potential crop for small farmers in the Delta. These tart, yellow-gold berries about the size of a cherry are considered a delicacy in Hawaii where they are used in jams and in Europe where they are chocolate covered.

*Soil and Water Research, Baton Rouge, LA*

*Xenia Wolff, (504) 771-2262*

Cotton varieties of the future may be armed against the fungus that causes verticillium wilt. *Gossypium barbadense* cotton, a long-staple type grown in Egypt, has natural high resistance to the disease. Researchers have discovered that's because when the fungus invades the cotton plant's roots and starts moving through its vessels, cells next to the infected vessel wall quickly swell, tightening the passageway where the invader lurks. This traps the fungus, holding it until a natural antibiotic produced by the plant can arrive and begin attacking it. The same defense system operates in *Gossypium hirsutum*, the cotton favored by U.S. growers. But it works so slowly that by the time the antibiotic arrives, the fungus has already spread throughout the plant. Attempts to crossbreed the two types of cotton haven't worked. But scientists can now check *G. hirsutum* lines with verticillium wilt resistance to see if quick response is their secret, and possibly cross those lines with more vulnerable types of *G. hirsutum*.

*Cotton Pathology Research, College Station, TX*  
Marshall E. Mace, (409) 260-9233

A natural toxin, thuringiensin, may someday help win the war against soybean cyst nematodes. In greenhouse studies, thuringiensin was as good at reducing numbers of nematodes as the nematicide aldicarb or bred-in plant resistance. In the field, however, the toxin didn't do as well. Researchers recovered fewer egg-producing nematodes from the resistant variety Fayette and also from a non-resistant variety treated with aldicarb. Even so, the study did show that thuringiensin, a product of the bacterium *Bacillus thuringiensis*, can be toxic to nematodes under field conditions. Researchers say it may be possible that the toxin could be genetically engineered into soybeans to combat nematodes while reducing environmental risk from pesticides.

*Crop Protection Research, Urbana, IL*  
Gregory R. Noel, (217) 244-3254

One-foot-square plots of wheat, planted alongside 1,600 miles of highways in five Southeast states, are giving researchers a more precise way to monitor outbreaks of leaf and stem rust. These rusts are the worst fungi-caused wheat diseases, costing farmers as much as \$500 million in years of heavy infection. In the past, researchers have had to depend on sampling farmers' fields and were at the mercy of what fields they could find and the varieties that happened to be planted. Now, tiny wheat test plots are planted every 20 miles or so along interstate highways in Georgia, Florida, Alabama, Louisiana and Mississippi. Researchers are in the fourth year of planting and checking for signs of rust in the fall.

*Plant Introduction Station, Griffin, GA*  
John Roberts, (504) 228-7335

Tiny fragments of plant DNA could be stepping stones to faster plant breeding. Scientists use enzymes to cut DNA, the genetic material of plants, into fragments of different lengths, each containing different genes. DNA probes then can be used to determine if a specific gene is present in a fragment. Once an association between a specific fragment and a specific gene is determined, selections can be made for plants with that fragment. For example, three seemingly different plants with resistance to a certain disease might all react to a specific DNA probe. If a similar reaction is seen in another plant, this could be an indication that the new plant has the same disease resistance evidenced by the other three. Checking for specific characteristics in this way, rather than through conventional plant breeding, can cut years off the time it takes researchers to find plants with just the right mix of traits.

*Crop Germplasm Research, College Station, TX*  
Keith F. Schertz, (409) 260-9252



## **Soil, Air and Water**

Farmers may gain higher wheat yields and lose less soil to erosion using a new planting technique. An ARS scientist modified a commercial, one-pass drill that places fertilizer below seeds in paired rows. That puts fertilizer in easy reach of plant roots, which is especially important if the roots are diseased. The drill also leaves residue from the prior crop on the soil surface to slow erosion. A third advantage: The drill helps control wheat root diseases by stirring up soil beneath the seed. Traditional plowing provides good control of root diseases but leaves soil vulnerable to erosion that can threaten the land's future productivity. While current minimum-till practices prevent erosion, they don't till soil enough to prevent disease or deposit fertilizer where it can be most accessible. The new system does much to solve these problems and could be especially valuable in areas where wheat is grown year after year with conservation tillage methods.

*Root Disease and Biological Control Research,  
Pullman, WA*

*R. James Cook, (509) 335-3722*

Even years of freezing winters can't undo the damage done to soil by today's behemoth farm machines. Northern farmers often assume that soils compressed by the tires of harvesting combines weighing 18 to 20 tons per axle, tractor-pulled wagons weighing 40 tons per axle and 1,200-bushel grain loading wagons will be loosened during the winter. The freezing and thawing action was thought to break up compacted soil and restore the tilth needed for the best yields. And it did just that decades ago when both farms and equipment were smaller. But a study in Minnesota showed today's equipment can compact soil down to almost 2 feet. The 1990 corn harvest on the test plots showed a 20 percent yield loss, 9 years after the initial compaction.

*North Central Soil Conservation Research Lab,  
Morris, MN*

*Ward B. Voorhees, (612) 589-3411*

Abandoned cropland in the Northeast can grow three vegetable crops a year when restored with sewage sludge compost or manure. ARS scientists have grown early cabbage, tomatoes and cauliflower all in 1 year on abandoned land in Maryland that was highly acidic and 97 percent sand. While most worn-out fields in the Northeast aren't that sandy, they are just as infertile. Yields were generally from 30 to 100 percent higher from plots that had compost or manure rototilled in once a year before planting cabbage than with commercial fertilizer applied with each crop. Except for cabbage, manure increased yields more than compost, suggesting that the compost might need to be applied more often or supplemented with nitrogen fertilizer to get the best yields for crops following cabbage. Compared with commercial fertilizer, both compost and manure improved soil quality much more, making it lighter and better able to hold moisture. Sludge outperformed the manure in improving soil quality.

*Soil Microbial Systems Lab, Beltsville, MD  
Cecil F. Tester, (301) 344-3386*

Mixing lime with compost might make the lime go farther. Literally, farther down in the soil. Scientists studying various fertilizers found that only on plots with composted sewage sludge was the lime able to favorably change soil pH deeper than the 6-inch rototilled layer. On plots with commercial fertilizer, the lime was effective only in the first 6 inches. Scientists theorize that the sludge compost chemically assists the movement of calcium from the lime. They are now designing follow-up studies to this surprise finding, which could be very helpful to farmers and gardeners dealing with acidic soils.

*Soil Microbial Systems Lab, Beltsville, MD  
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Plant yields increased 1-for-1 as atmospheric levels of carbon dioxide were elevated. Likewise, higher CO<sub>2</sub> levels also promoted greater water use efficiency—the amount of plant productivity per unit of water used. Those were the findings when researchers grew assorted plants in a chamber where controlled CO<sub>2</sub> levels ranged from a low of 150 parts per million—below those of pre-industrial times—to 350 ppm, the approximate current level. When atmospheric CO<sub>2</sub> is scarce, plants must open wide the openings in their leaves, called stomata, to take in enough for photosynthesis. But the yawning stomata allow precious water to escape. If CO<sub>2</sub> is plentiful, however, the stomata aren't stretched as wide and water is conserved.

*Grassland Protection Research, Temple, TX  
Herman S. Mayeux, Jr., (817) 770-6500*

Evidence grows that some herbicides and insecticides can return to the Earth in rain, snow, dew and fog—depositing significant amounts of the chemicals where they were not applied. ARS scientists analyzed rainfall water samples collected along the eastern shore of the Chesapeake Bay during the summers of 1981, 1982 and 1984. They estimate that during each of the three summers 1,323 pounds of atrazine, between 3 and 11 tons of alachlor, 1,190 to 2,325 pounds of toxaphene and 242 to 309 pounds of simazine fell on the Bay in rainfall. Toxaphene, an insecticide, is now banned by the Environmental Protection Agency. The other three chemicals are herbicides, most frequently used on corn. These analyses, along with previous ARS studies, indicate that some farm chemicals travel hundreds of miles by air before coming to rest on land or in waterways such as the Bay.

*Environmental Chemistry Lab, Beltsville, MD  
Jack R. Plimmer, (301) 344-3511*

## **Insect and Weed Research**

Fifteen queen honey bees that resist tracheal mites have been brought here from England, in an effort to breed resistance to these mites in U.S. bee colonies. The mites can destroy more than 80 percent of a colony. Bred by a 92-year-old English monk named Brother Adam, the resistant bees withstood mite attacks even when other bees nearby collapsed. ARS scientists are quarantining the newly imported bees for 6 months until they are sure the bees carry no disease. They then will crossbreed the queens' offspring with other mite-resistant bees and eventually incorporate resistance into crop-pollinating and honey-producing bees. The project should take 2 or 3 years. Queens resulting from the research will be distributed to bee breeders who can incorporate the resistance into their colonies for sale to beekeepers.

*National Program Staff, Beltsville, MD  
Ralph A. Bram, (301) 344-2771*

Gypsy moths have more reason to be afraid of baldfaced hornets than do people. While doing other biocontrol work on gypsy moths, an ARS scientist watched baldfaced hornets turn free-flying moths into fast food for baby hornets. In about 3 minutes, the hornet attacked and immobilized its prey in mid-air, carried the corpse to a nearby perch, severed the wings and other extremities, softened the carcass with some chewing and flew back to the nest with it. The fierce-looking hornets, black with whitish face and body markings, pack a mighty sting but generally ignore people unless disturbed. They are persistent predators of many insects including the gypsy moth. While scientists don't foresee mass releasing the baldfaced hornet to patrol parks and forests, their discovery of its appetite for gypsy moths means it can be added to natural defenses against these spreading pests.

*Beneficial Insects Research Lab, Newark, DE  
Paul W. Schaefer, (302) 731-7330*



Two major cotton pests in the Mississippi Delta have been victimized by an old virus playing new tricks. Researchers sprayed weeds surrounding cotton fields with a *Heliothis* nuclear polyhedrosis virus, a natural enemy of the cotton bollworm and tobacco budworm. As immature insects, these pests feed on weeds before emerging into adult moths and attacking nearby crops. But 38 percent fewer cotton bollworms and 31 percent fewer tobacco budworms emerged from the treated weeds. These viruses attack only insects like these that have an alkaline mid-gut, and therefore will not harm people, animals, plants, the environment or beneficial insects. Each year Delta farmers suffer \$50 million in damages and added pesticide costs because of these two pests. Sandoz Crop Protection, Inc. makes the virus under the tradename Elcar.

*Southern Insect Management Lab, Stoneville, MS*  
*Marion R. Bell, (601) 686-2311*

Relief may gradually come for many crops pestered by a bug that sucks sap from flowers and young fruits. That's because a parasitic wasp from Europe is showing it can survive and multiply in New Jersey and New York and might do the same in the South and West. The one-eighth-inch-long *Peristenus digoneutis* wasp doesn't sting animals or people. But after the female stings and lays an egg in the immature nymph of the tarnished plant bug, a wasp larva hatches and eats the nymph. Last summer, the wasps—descendants from small releases made several years ago in New Jersey—parasitized up to 90 percent of tarnished plant bugs in alfalfa fields sampled in north New Jersey. If the wasp can quell the bugs in alfalfa, fewer of them would survive to fly away when the hay is cut to infest strawberry fields, fruit orchards and vegetables such as green beans. Researchers, who report the wasp has migrated to southern New York, have made new releases in southern New Jersey and will do the same in Delaware next summer. They say the wasp also may prove useful in the South, where tarnished plant bugs attack cotton. And the pest's western relative, the lygus bug, damages strawberries, cotton and alfalfa grown for its seed. In California, the wasp might be an alternative to insecticides or huge, field-going "vacuum cleaners" that suck lygus bugs off strawberry plants.

*Beneficial Insects Introduction Research, Newark, DE*  
*William H. Day, (302) 731-7330*  
*European Parasite Research Lab, Behoust, France*  
*Keith Hopper, 011-3313-487-2075*

Broccoli and cabbage growers could enlist beneficial wasps and flies to ward off damage from crop-munching caterpillars. Carefully timed releases of seven different species of parasitic wasps and flies killed populations of three major caterpillar pests in experimental broccoli plots. Damage from the pests—cabbage loopers, imported cabbage worms and diamondback moths—costs growers of broccoli, cabbage and other cruciferous vegetables over \$35 million each year. One-acre test plots received 150, 300 or 600 pairs of each of the seven beneficial parasites, which lay their eggs in the caterpillars. Larvae that hatch from the fly and wasp eggs feed on the pests, eventually killing them. The test plots at the two highest release rates had only 5 percent insect damage, compared to 25 percent in the unprotected control plot. Biological control methods, such as beneficial wasps and flies, could reduce or eliminate grower's reliance on pesticides.

*Fruit and Vegetable Insect Research Lab, Yakima, WA*  
*Duane K. Biever, (509) 575-5945*

A microscopic Mediterranean mite with a taste for a troublesome weed is being tested in Texas and New Jersey to see if it can repeat its overseas successes. *Aceria malherbae* attacks field bindweed, a perennial weed that thrives across most of the United States. A member of the morningglory family, the weed twines around other plants, sends roots deep into the soil and can wreak havoc by becoming entangled in crop harvesting machinery. Its tiny enemy, *A. malherbae*, was discovered in Greece after researchers there noted significant damage to the weed (*Convolvulus arvensis*). Tests in Greece and later at Albany, California, indicate the hair-like white mite feeds exclusively on field bindweed. Up to 1,000 of the mites were released on two occasions last year at Bushland, Texas and in New Jersey. Field surveys this spring showed the mites survived the Texas winter. Further evaluations of the mites' impact on the weed are scheduled for this fall in New Jersey and Texas.

*Grassland, Soil and Water Research, Temple, TX*  
*Paul E. Boldt, (817) 770-6530*

A rust from Turkey could be a new biological control for suppressing weed yellow starthistle—an imported, noxious thorny weed that poisons horses, crowds out nutritious forage and scratches hikers. In greenhouse tests, the rust—a fungus named *Puccinia jaceae*—has killed the thistle but not harmed other plants. It cut back thistle roots by 39 percent and shoots by 50 percent. Since the rust is most effective when temperatures reach 70 degrees F and when dew lasts for about 14 hours—conditions similar to the western United States where yellow starthistle is most prevalent—it could easily become established to start controlling the weed. If approved by USDA's Animal and Plant Health Inspection Service for release, *Puccinia jaceae* could be used by farmers and weed-control agencies as part of a management program to suppress yellow starthistle.

*Foreign Disease-Weed Science Research, Frederick, MD*  
A. Rick Bennett/William L. Bruckart, (301) 663-7344

A tiny weevil may be a friend to western ranchers battling yellow starthistle. *Eustenopus villosus*—dubbed the yellow starthistle hairy weevil because of the short, soft hairs on its back—was collected by an ARS scientist in Greece this summer. ARS and state cooperators then made the first-ever release of the weevils at thistle-infested sites in California, Oregon, Washington and Idaho. In its larval (wormlike) stage and as a quarter-inch-long adult, *E. villosus* thwarts yellow starthistle's reproduction and spread by feeding on flowerhead tissue that would otherwise develop into seeds. Now the insects must reproduce and survive the winter if they are to establish colonies that could help bring the weed under control.

*Plant Protection Research,*  
*Western Regional Research Center, Albany, CA*  
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*Biological Control of Weeds Lab, Thessaloniki, Greece*  
Rouhollah Sobhian, 30-31-473-272  
*Biological Control of Weeds Lab, Rome, Italy*  
Luca Fornasari, 39-6-507-0140  
*Regional Plant Introduction Station, Pullman, WA*  
Stephen L. Clement, (509) 335-3572

## **Scientific Information Systems**

A new airborne video system could pave the way for faster action against crop and range pests. So far, researchers can use the videotapes to reveal more than a dozen crop conditions such as sooty mold on citrus, chlorosis on grain sorghum, soil salinity, rice borers in sugar cane, nitrogen deficiency and crop vigor. Private consultants could soon offer such tapes to farmers and ranchers to supply information faster and cheaper than aerial photos and satellite data. Videos are made by three synchronized cameras. Each is equipped with a different narrow-band filter: red, yellow-green or near infrared. On a plane flying at 3,000 to 12,500 feet, the images are fed separately into three Super-VHS recorders while a fourth recorder gets a composite, color-infrared image. On the ground, freeze-frame color images can be converted to digital data for computer analysis.

*Remote Sensing Research, Weslaco, TX*  
James H. Everett, (512) 968-5533

No, it's not the latest pop-rock radio station, but WGEN is still a big hit around the world. WGEN—for "Weather Generator"—is a computer model that considers past weather patterns in calculating what the future weather might be like at a specific site. It could be used by farmers, but WGEN is most often put to work developing the weather data that's an integral part of other computer models, including those for farm management decisions. WGEN's users already include universities, agricultural chemical companies and researchers from Europe, Africa, Australia and Central and South America. Historical weather information locally is plugged into the model. In return, it reports on likely daily rainfall, temperatures and solar radiation for any period in the future. A personal computer can pour out 50 year's worth of calculations in about 5 minutes.

*Grassland, Soil and Water Research Lab, Temple, TX*  
C.W. Richardson, (817) 770-6500



Controlling insect populations will become easier thanks to a new mathematical model. The model predicts pheromone release rates under any set of environmental conditions. Researchers use thimble-sized rubber plugs—that are “dosed” with synthetic pheromones—to help monitor and control insect populations in orchards, fields or vineyards. The attractants slowly evaporate into the air, thus disrupting mating since the air is permeated with the synthetic attractant. But weather conditions, like sun, wind or rain, can speed up or slow down the release of the pheromones. The new model should help researchers develop the best formulas for these attractants. It will also provide industry and farmers with information on correct doses and when the dispensers need to be replaced. The model is presently being used to develop a formula to disrupt mating of the codling moth—the principal pest of apples.

*Fruit and Vegetable Insect Research, Yakima, WA*  
*Leslie M. McDonough, (509) 575-5970*

Ranchers can get answers from SMART, a new computer program, on how many head of cattle to put on rangeland without overgrazing. SMART—for Simple Model to Assess Range Technology—accurately matches the number of yearling cattle to the available forage. A rancher's stocking rate, initial weight of steers, total annual forage production and dates of grazing are entered in the computer. Then SMART prints out forage supply and gains for each day and the totals for the grazing season. It's possible to try several stocking rates and levels of forage production so a rancher can evaluate the results and potential income and then decide which alternative to adopt. A copy of the program is available to ranchers and state extension specialists.

*High Plains Grasslands Research Station, Cheyenne, WY*  
*Richard H. Hart, (307) 772-2433*





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# Quarterly Report

## of Selected Research Projects

United States  
Department of  
Agriculture  
  
Agricultural  
Research  
Service



October 1 to December 31, 1990

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### Biological Control

Four days of feeble nibbling was about the limit for pesky caterpillars trying to feast on new, genetically engineered cotton plants. Then the pests died. That's according to results from the plants' first outdoor field tests conducted in six states last summer by ARS and cooperating scientists. Caterpillar damage was almost nil because new genes, inserted by scientists at Monsanto Co., enabled the plants to produce proteins that made the pests too sick to eat more than a few bites of plant tissue. Growers could cut out nearly all insecticide sprays for caterpillars if the new approach passes all its hurdles—including the need to breed the proteins into high-quality cotton varieties. Currently, growers commonly spend \$50 to \$75 an acre on these insecticides; many spray more than 10 times per season. The plants' new genes came from *Bacillus thuringiensis*, or Bt, a natural bacterium long sold as a safe bioinsecticide. In nature, Bt manufactures proteins that are toxic to many cat-

terpillar species. The new cotton plants make similar proteins that kill tobacco budworm, cotton bollworm, pink bollworm, beet armyworm and others. ARS tested the plants with Monsanto and university cooperators in Mississippi, Texas, Arizona and California. This summer, more tests will be run including trials with different Bt genes and a study to see how well the new genes are inherited.  
*Southern Crops Research, College Station, TX*  
*David Altman, (409) 260-9314*  
*Crop Science Research, Starkville, MS*  
*Johnie Jenkins, (601) 323-2230*  
*Cotton and Insect Genetics Research, Phoenix, AZ*  
*F. Doug Wilson, (602) 379-3524*

A beneficial fungus called *Gliocladium virens* has been approved by the Environmental Protection Agency as a greenhouse biological control agent for two plant diseases. ARS has patented the technology for formulating the fungus into a pellet and awarded W.R. Grace and Co. an exclusive license to develop this technology into a commercial product. It's the first beneficial fungus approved to control a plant disease. *Gliocladium virens* reduces plant loss by 80 to 95 percent in crops attacked by *Rhizoctonia solani* and *Pythium ultimum*. These two fungi rot seeds, seedlings and/or cuttings of geraniums, snapdragons, chrysanthemums, poinsettias, cotton, corn, soybeans and tomatoes. Called "damping off," the disease can destroy 10 to 30 percent of a crop, and together the fungi cost agriculture and horticulture more than \$1 billion a year. ARS researchers isolated *Gliocladium* and formulated it into an easily applied wheat bran pellet for the soil. W.R. Grace plans to eventually apply to EPA for field use of the fungus. (PATENT)  
*Biocontrol of Plant Diseases Lab, Beltsville, MD*  
*Robert D. Lumsden (301) 344-3679*

A mix of fungi or nematodes and a coarse ground flour called semolina—normally used to make pasta—shows promise as a biological control of insects and weeds. ARS scientists found, in greenhouse tests, that this combination, called Pesta, may curb insect and weed damage to crops, other plants and lawns. A water slurry of either fungi or nematodes is blended with a mixture of wheat flour, clay powder and other ingredients to make a dough. One fungal

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

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product completely wiped out hemp sesbania, a weed commonly found in soybeans, rice and cotton, within 7 days of application. Pesta containing other weed-killing fungi also showed promising results against sicklepod and jimsonweed. One nematode-containing product resulted in 63 percent fewer adult corn rootworms after 21 days. Other products also may be useful for controlling white grubs, sod webworms, the Colorado potato beetle and other insect pests. (PATENT)

*Composition and Properties Research, New Orleans, LA*  
*William J. Connick, Jr., (504) 286-4527*

*Nematology Lab, Beltsville, MD*  
*William R. Nickle, (301) 344-3064*

**A natural genetic parasite is sabotaging cucumber mosaic virus**, which causes plant disease of sometimes epidemic proportions in many countries. Scientists in the United States, Italy, France, Japan and China are testing the parasite, known as a viral satellite. It is a small molecule of nucleic acid named S-CARNA 5. ARS researchers, who discovered S-CARNA 5 in 1976, are testing and supplying it to other scientists. The virus commands plant cells to make enzymes it needs to multiply, but S-CARNA 5 robs these enzymes so the virus has too little and starves. Cucumber mosaic is the No. 1, 2 or 3 worst virus in 16 countries, where it attacks cucumbers, tomatoes, peppers, spinach, celery, cowpeas and other crops. In the United States, it causes noticeable losses in peppers, squash and melons. Nearly all satellites have been found by chance, but ARS scientists have begun a systematic search for satellites that could destroy other plant viruses. The toughest tests of S-CARNA 5 so far were conducted in 1989, amid an epidemic of cucumber mosaic in a southern Italian commercial tomato field. Italy's University of Bari ran the tests in cooperation with ARS and the University of Maryland. Fewer than 10 of 200 tomato seedlings injected with the satellite developed virus disease, while 40 percent of the field's unprotected plants died. ARS researchers also have discovered that S-CARNA 5 has potential to be the first useful natural control against a viroid that causes potato spindle tuber disease, which results in stunted, misshapen tomato plants and spindly, split-open tubers.

*Microbiology and Plant Pathology, Beltsville, MD*  
*Jacobus M. Kaper, (301) 344-2571*

**Some predatory insects are gluttons** when it comes to devouring crop-destroying insects. Other predators are not. That can make all the difference in deciding which beneficial predators to mass-rear and release to control insect pests in lieu of using insecticides. To speed their search for the hungriest predators, ARS scientists modified a test originally developed for studying elusive viruses in human medical research. The first of the new insect tests is now available; it's for finding predators of lygus bugs in cotton fields. Researchers are now developing tests for predators of whiteflies, small insects that cause close to \$1 billion damage annually to U.S. crops. The tests are simple and relatively inexpensive. Samples from hundreds of insects can be analyzed in a few hours.

*Carl Hayden Bee Research Center, Tucson, AZ*  
*James Hagler/Allen C. Cohen, (602) 670-6380*

**A mite from Europe has been given the okay** for a big job—controlling one of the worst weeds strangling U.S. crops. An ARS entomologist proved that the mite, *Aceria malherbe*, only attacks field bindweed, a vinelike weed that looks like an out-of-control morningglory. Scientists have made several test releases in the southwest recently to see if these bugs will thrive and control this weed. Field bindweed, the 15th worst weed in the United States, can choke crop plants to death by growing around their stalks or stems. Most serious in western and midwestern corn and wheat fields, it is difficult and expensive to control with herbicides and cultivation.

*Rangeland Insects Lab, Bozeman, MT*  
*Sara S. Rosenthal, (406) 994-4892*  
*Biological Control of Weeds Lab, Thessaloniki, Greece*  
*Rouhollah Sobhian, 011-3031-473-272*



**A tiny parasitic wasp may offer new hope** for controlling the Russian wheat aphid, depending on where the aphid dines. The wasp, *Diaeretiella rapae*, deposits its eggs into the aphids and the developing young feed on their hosts. Lab experiments showed the wasp did not thrive on aphids feeding on triticale, a wheat-rye cross. Triticale produces a natural antibiotic that hinders aphid reproduction. By contrast, wheat varieties that were more tolerant of aphids became a wasp paradise. The wasps found the aphids easy pickings because the plant leaves did not roll up, like leaves of susceptible wheat. Coincidentally, this protects the attacking aphids. Studies suggest wasps could be mass-released to reduce overall aphid populations and help protect more vulnerable wheat varieties.

*Wheat and Other Cereal Crops Research, Stillwater, OK*  
David K. Reed, (405) 624-4407

**The newest enemy of the dreaded Medfly** may be among a collection of 3,000 fungi being tested at Ithaca, New York. These fungi are being checked for possible natural enemies of the destructive Mediterranean fruit fly and its calamitous cousin, the Caribbean fruit fly. Fungi are known to attack insects, but each fungus usually has a specific target. About 400 fungi from tropical areas are being checked first at Ithaca. Each fungus is grown in a nutrient-rich broth. Then chemicals produced by the fungus are extracted from the broth and from fingerlike fungal growth called mycelium. These chemicals are fed to hungry flies, which are checked at 12, 24 and 48 hours for signs of ill effects. If researchers find an extract that kills the flies, it could become the foundation for a natural, economical product for fighting the nation's primary exotic fruit pests.

*Plant Protection Research, Ithaca, NY*  
Stuart B. Krasnoff, (607) 255-5404

**Some good news and some bad news** about a Greek weevil, imported to the western states in 1985 to help control yellow starthistle. This weed crowds out nutritious forage on millions of acres and poisons horses. The good news: The beneficial weevil, *Banagsternus orientalis*, is still doing a great job of destroying seeds by feeding inside the flowerheads, and is expected to continue doing so. The bad news: The weevil is being attacked by a native parasitic wasp. In three California counties, wasp damage to the

beneficial weevils was measured at only 0.08 of a percent. Identified as *Microdontomerus anthonomi*, the wasp in its larval, or immature stage, feeds on weevil larvae that live in the weed's flowerhead. Another bit of good news, the wasp also parasitizes destructive plant-feeding insects such as boll weevils, seed-feeding beetles and several moth caterpillars.

*Plant Protection Research, Albany, CA*  
Charles E. Turner, (415) 486-3205  
*Systematic Entomology Lab, Washington, DC*  
E. Eric Grissell, (202) 382-1781

**A fly that attacks the Colorado potato beetle** was collected in Brazil by U.S. and Soviet scientists, in the first joint exploration for biological pest controls. Scientists from both countries met in Brazil for three weeks to hunt biocontrols for the beetle, because it is the most costly potato pest in both countries. In the United States, losses and control cost farmers \$150 to 200 million a year. The fly parasite is being evaluated at an ARS facility now. Any information scientists learn will be passed along to their Soviet colleagues.

*Insect Biocontrol Lab, Beltsville, MD*  
Robert Schroeder, (301) 344-2369

**Ragweed relief may soon be spelled I-N-S-E-C-T-S**, at least for citizens of the Soviet Union. Last August, U.S. beetles and moths that gobble American ragweed leaves were shipped to Leningrad along with pollen-eating beetles and fruit flies that dine on ragweed flowers. A Soviet entomologist netted the bugs during his eight-state exploration last summer, aided by ARS and university scientists. In North America, ragweed's native home, natural enemies help hold the pest down. But the plant has pestered Soviet crops and sinuses since it invaded the USSR in the early 1900's, escaping from its natural enemies. Now, in weed-infested fields and pastures, Soviet scientists will release promising bugs collected in the United States. The 1990 trip was the first to this country by a Soviet scientist under a 1989 ARS-Soviet pact to expand joint studies and explorations for organisms to control pesky weeds, insects and plant diseases.

*Insect Biocontrol Lab, Beltsville, MD*  
Stephen D. Hight, (301) 344-1125

Take one ounce of fungal spores, add the right herbicide, mix well...and it's goodbye, weeds. Researchers are pinpointing precisely which commercial herbicides can be combined with natural weedkillers such as fungi to eliminate two or three weeds in one shot. A basic ingredient in these "recipes" is the fungus *Colletotrichum gloeosporioides*, which wipes out the weed northern jointvetch in rice fields. Spores of the fungus can be blended with the herbicide acifluorfen to nail hemp sesbania at the same time. Combining the spores with the herbicide bentazon works well against a northern jointvetch-redstem weed invasion. Fungicides also have been found that can be mixed with the spores to fight weeds and diseases simultaneously. Research so far has focused on problems in rice, but similar combinations should work in other crops as well.

*Rice Production and Weed Control Research,  
Stuttgart, AR*

*Roy J. Smith Jr., (501) 673-2661*

### **New and Improved Products**

**Hydrilla and other weeds that clog marinas, lakes and irrigation canals** might be stopped by a chemical that's more effective than—yet, just as environmentally safe as—other herbicides already in use. Western states alone spend an estimated \$50 million every year battling water weeds. ARS experiments in greenhouses and irrigation canals showed that the commercially made compound, bensulfuron methyl, stunts young weeds such as hydrilla and Eurasian watermilfoil. What's more, the chemical blocks hydrilla from forming structures called tubers and turions that enable it to reproduce and spread. Other test results in fish-ranch ponds, private and public lakes and irrigation canals will be used by the compound's manufacturer in seeking U.S. Environmental Protection Agency approval for this new use of the chemical. It's already approved for fighting weeds that infest rice paddies.

*Aquatic Weeds Control Research, Davis, CA*

*Lars W.J. Anderson, (916) 752-6260*

**Ginners could process Pima cotton** twice as fast and with less cost. Southwestern cotton farmers these days are growing about three times more high-value Pima cotton, because of its popularity in luxurious consumer fabrics. Pima cotton has longer fibers than the upland varieties that go to make most cotton fabrics, but it is more readily damaged in the ginning process. Nevertheless, farmers are paid 50 to 70 percent more for the longer fiber. The ginning improvements, developed by ARS engineers, include a computer and a cooler. The computer automatically controls the flow of seed cotton to the gin rollers that remove the fibers from seed. The cooler extends the life of the expensive rollers by preventing overheating. Since the early 1980's, farmers in Texas, New Mexico, Arizona and California have increased the average annual plantings of Pima cotton from 90,000 to 230,000 acres.

*Southwest Cotton Ginning Research Lab,  
Mesilla Park, NM*

*Marvis N. Gillum, (505) 526-6381*



**Future cotton fibers will be stronger and finer.** And the plants producing the fibers could have higher yields and superior insect resistance if breeders can give today's commercial varieties traits from eight recently released genetic lines. These new lines were developed by ARS and the Arizona Agricultural Experiment Station. One of the new lines grows longer fibers, three lines grow stronger fibers and two lines grow finer fibers. Three lines also produce mature bolls faster, allowing earlier harvesting and reducing the risk of damage by rain late in the growing season. All the lines should help thwart the pink bollworm, cotton's worst pest in irrigated desert areas of Arizona and southern California.

*Western Cotton Research Lab, Phoenix, AZ  
F. Douglas Wilson, (602) 379-3524*

**American soybeans are scoring higher** in quality upon arrival in European and Asian ports. A 4-year study showed American beans grown in the late 1980's landed abroad with fewer damaged kernels than those found in samples from Brazil, a major competitor. Findings from the study could help point the way to increasing further the quality of U.S. soybeans—through improved grain handling, expanded breeding research and new genetic engineering studies of the commodity. On the other hand, American soybeans contained more foreign material and were lower in protein and oil content than South American beans. But the U.S. beans generally proved less prone to oil refining losses associated with split or damaged seeds.

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Rotterdam, Netherlands  
Anton J. Bongers, 011-31-10-476-5233*

**Omega, a new flax variety,** packs three pluses in its seed. First, it contains omega-3, a family of fatty acids that researchers think may help reduce a person's risk of developing cardiovascular disease. Second, Omega's golden-tinted seeds are ideally suited for grinding and blending into flour to impart a nutty flavor to baked products. Additionally, Omega is the first yellow-seeded flax variety with genes to resist all prevalent races of rust diseases in North America—a bonus for farmers. Omega's yields in tests have been similar to those of typical brown-seeded flax varieties. Omega, developed by ARS and North Dakota State University scientists, may be ready for full production as early as 1992.

*Oilseeds Research, Fargo, ND  
Jerry F. Miller, (701) 239-1321*

**Cholesterol-lowering compounds in oats** might be added to those breakfast cereals and other foods that now contain little or no oats. These include breads and the cereal extenders in some processed meats. Beta-glucans are natural compounds found mainly in cell walls of oat kernels. Now, ARS researchers have a new method for recovering beta-glucans in a concentrated powder. Levels of beta-glucans were two to five times higher in the concentrate than in an equal volume of natural oat bran or rolled oats. The method has two advantages that raise its efficiency and potential appeal to commercial millers. First, it is a dry-milling process. This is more desirable than wet milling with a water-enzyme mixture that could damage the beta-glucans. Second, the method gives a surprisingly high—that is, 20 to 38 percent—yield of concentrate. That means 20 to 38 pounds of the powder could be made from 100 pounds of oat bran or rolled oats. The remaining material isn't waste; it can be used as flour. Further tests will refine the method and improve its commercial potential.

*Food Quality Research, Western Regional  
Research Center, Albany, CA  
Benny E. Knuckles/Antoinette A. Betschart/  
Mei-Chen M. Chiu, (415) 559-5693*

**Hawaii's premium avocado**, the smooth and creamy Sharwil, is being shipped to the mainland this winter, thanks to experiments by an ARS scientist. Tests were made on more than 200,000 avocados in the lab, avocado groves and packinghouses to ensure that fruit flies, such as the Medfly, can't stow away in fruit shipments. USDA's Animal and Plant Health Inspection Service relied on that research in lifting a ban that had long prohibited shipments of Hawaii's avocados to any state except Alaska, where the climate is too cold for tropical fruit flies. ARS experiments indicated that the best chemical-free tactics for outwitting the flies include leaving avocado stems attached when harvesting the fruit and, within 12 hours after harvest, packing the fruit in fly-proof containers at fly-free packinghouses. Pebbly-skinned Sharwils are about twice as big as the popular Hass avocado.

*Tropical Fruit and Vegetable Research Lab, Hilo, HI  
John W. Armstrong, (808) 959-9138*

**Miniature iceberg lettuce** may appear in trendy restaurants and supermarket produce sections by 1993. Only the size of a tennis ball, this ARS-developed lettuce is ideal for people who can't seem to use up a whole head of lettuce while it's still fresh. Cut into wedges, the mini-lettuce makes a single-serving salad. It boasts the same crisp texture, sweet taste, and tightly formed head as commercially grown iceberg lettuce. ARS scientists produced the new variety by first soaking thousands of germinating lettuce seeds in an ethyl methanesulfonate compound. Plant researchers and breeders commonly rely on this approach to change how plants grow. The soaking altered a gene critical to a natural growth hormone called gibberellin. This caused some of the plants to produce 90 percent less of the hormone than their regular-size cousins. When scientists crossed the new plants with Salinas iceberg—a popular, full-sized variety bred by ARS—they obtained one midget lettuce that's the familiar green and another with blush-red outer leaves.

*U.S. Agricultural Research Station, Salinas, CA  
Edward J. Ryder/William Waycott, (408) 755-2800*

**Consumers who savor the nutlike taste of wild rice** may be able to buy graded rice within 3 to 5 years. That's because ARS scientists have refined techniques for assigning grades to wild rice, somewhat like those used for other grains, or meat and poultry products. California's wild rice growers asked the scientists to provide easy-to-follow steps that grain inspectors can use to weigh, measure and judge rice accurately and consistently. Growers and processors contemplate a grading system that will apply to the freshly harvested "green" grain or the familiar processed rice—the roasted, glossy black or light brown grains you buy at the store by the box, bag or scoop. Consistency within each grade and among growers and processors is especially important to food manufacturers who buy wild rice for packing in mixes with white or brown rice. In those products, all grains must cook uniformly in the time shown on the box. Once growers and processors agree on grading procedures and standards, the next step will be to propose a federally approved grading system.

*Food Quality Research, Western Regional  
Research Center, Albany, CA  
Albert P. Mossman/Robert N. Sayre, (415) 559-5651*

**Squalene, a natural skin lubricant** in humans and a feather lubricant in birds, can also protect grapefruit from chilling injury. Chilling injury doesn't harm the fruit, but causes brownish pits on the rind that lessen market value. An ARS chemist found squalene in the wax of grapefruit rind. Tests showed that storing the fruit for 7 days at 60 degrees F increased the level of squalene 33 times. That temperature caused fruit to produce the most squalene. In one storage test, only 6 percent of conditioned fruit developed chilling injury compared to 97 percent not temperature conditioned. Squalene had not been identified in citrus before. It is present in large quantities in shark liver oil, olive oil, wheat germ oil, rice bran oil and yeast.

*U.S. Horticultural Research Lab, Orlando, FL  
Harold E. Nordby, (407) 897-7300*



**A coating technique similar to one used on wood, metal and floor tile can now be used for leather.** Tanneries have been looking for ways to replace solvents that—without careful handling and government regulation—could subject workers and the public to potentially harmful vapors. ARS scientists have found a way to use solvent-free formulations that can be applied to leather and cured by ultraviolet light. This produces attractive and durable products, while reducing health and environmental concerns. The process also saves energy costs for tanneries. The ARS technology has attracted worldwide interest from the leather finishing industry. A French leather research institute recently modified the technology and is test-marketing its product.

*Hides, Leather and Wool Research, Philadelphia, PA*  
*Frank Scholnick, (215) 233-6511*

**Farmers in the future may handle agricultural chemicals safer,** thanks to a prototype system developed by ARS engineers. Without ever coming in direct contact with the chemicals, farmers can open chemical containers, mix the products, pump the chemicals into spray-rig tanks and rinse the containers. The 4-foot by 2-foot metal box has doors on the side and a glass front equipped with neoprene gloves. Users put the unopened product containers inside the box, close the doors and place their hands in the gloves to open and handle the product. Attachments on the box allow for the addition of water and the rinsing of the containers and box. A pump in the bottom mixes the chemicals, then sends them into a tractor's spray-rig tank. Using the system adds 5 to 8 minutes to chemical mixing time.

*Field Crops Mechanization Research, Stoneville, MS*  
*J.R. Williford, (601) 686-2311*

**Certain bacteria and fungi produce enzymes that degrade natural waxy barriers on the surface of leaves formed by a material known as cutin.** ARS scientists hope these enzymes may one day be added to herbicides and other agricultural chemicals so they are more rapidly absorbed into openings within a plant's leaves. Bacteria appear to be the best candidates as sources of this enzyme because bacterial enzymes can withstand heat. ARS scientists are studying various bacteria, including four species of *Streptomyces* and eight species of *Pseudomonas*, as sources of

enzymes that degrade cutin. However, scientists must determine if these openings in plant leaves will allow entry of unwanted bacteria, fungi and insects. Also, scientists must ensure that this increased permeability allows herbicides to more effectively kill weeds, but not harm fruits, vegetables and crops. This technology may help prevent chemicals from leaching into groundwater because they are more efficiently absorbed by the plant through the stomates. Also, the need for fewer chemical applications could cut farming costs.

*Plant Science Research, Philadelphia, PA*  
*Robert A. Moreau/William F. Fett, (215) 233-6428*

**For more efficient honey production,** beekeepers should focus on the queen bee, studies show. To breed better honey producers, beekeepers can rear new generations of queens from high weight-gaining colonies (those that make the most honey) without selecting males. Allowing females to mate at random is easier than standard breeding practices that require selection of both males and females. Those practices require beekeepers to bring selected males and females to an isolated mating station, or inseminate the queen with semen from selected males. Tests also show that increases in hive weight after just 1 month of honey production correlate with increases over the whole season. That means beekeepers can select and rear queens in the same season, instead of evaluating colonies the first year and rearing queens the next, as is usually done. Beekeepers can achieve the same rate of progress in as little as a third of the time.

*Bee Research Lab, Beltsville, MD*  
*Nicholas Calderone, (301) 344-3974*

## Human Nutrition

**Getting enough calcium and zinc** in people's diets is a worldwide problem, according to preliminary results from the first uniform international study of mineral intakes. Analysis of one-third of 450 sample diets collected from 11 developed and developing nations—including the United States—showed the calcium content ranged from 25 to 75 percent of the U.S. RDA, while zinc content measured between 55 and 95 percent. ARS scientists were involved in designing the study and developed the composite-diet standard being used by the eight international testing labs to ensure uniformity of results. The study, coordinated by the International Atomic Energy Agency in Vienna, Austria, is looking at intake levels of 23 elements, including 6 toxic elements. So far, all nations exceed the U.S. RDAs for potassium, magnesium, molybdenum and the constituents of table salt—sodium and chlorine. The lowest U.S. intake was for calcium at 70 percent.

*Nutrient Composition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD*  
Wayne R. Wolf, (301) 344-2927

**People in lesser developed countries**, who must rely heavily on small grains for food, are being shortchanged on some of the grains' calcium and trace minerals. This is because phytic acid (or inositol hexaphosphate), a natural compound in rice, wheat and other cereals, prevents nutrient absorption in the intestinal tracts of humans and livestock. A plant geneticist has found that the phytic acid content in wheat is directly related to the kernel's protein and phosphorus contents. This finding poses a dilemma for plant breeders—if they were to breed grains with lower phytic acid, the grain also would have less protein and phosphorus. To solve the problem, the geneticist is using tools of biotechnology to develop germ-plasm that does not produce phytic acid. This germplasm might provide the parents of future small grain varieties that would supply more total nutrients.

*Cereal Crops Improvement, Bozeman, MT*  
Victor Raboy, (406) 994-5054

**To see if you're getting enough niacin**, physicians may someday use a technique developed by researchers at ARS and the University of California at Los Angeles. The new approach relies on a small sample of blood, so it's more convenient than a urine test that requires round-the-clock

collections. Niacin comes from eating meat and dairy products. In the body, it is converted into niacin's two most important forms, NAD or NADP. Cells use these two forms in many ways, such as to burn fuel for energy and to repair genetic material. In volunteers fed low-niacin meals, red blood cell levels of NAD dropped some 70 percent, but NADP levels didn't change. Those volunteers with an NAD-to-NADP ratio of less than 1 were niacin-deficient. Using this ratio as an early signal of niacin depletion is new. With more work, a test based on the ratio could become part of routine health checkups in the United States. It could also aid health workers in developing countries gauge progress in fighting severe niacin deficiency and its resultant disease, pellagra.

*Biochemistry Research, Western Human Nutrition Research Center, San Francisco, CA*  
Robert A. Jacob, (415) 556-3531

**Regular aerobic training can improve fitness** of inactive people in their 60's just as much as couch potatoes in their 20's. But the improvements occur differently in each age group, a study shows. Researchers measured both the aerobic and oxygen-burning capacity of thigh muscle in 20 men and women. They were tested before and after 12 weeks of cycling 3 times per week. Gains in aerobic capacity were about the same for both groups. But virtually all the older group's improvement was due to the ability of their muscles to use more oxygen—not in the ability of their hearts to pump more blood, which delivers more oxygen to the muscles. By contrast, the younger group improved in both functions. The findings corroborate other reports that endurance exercise improves older people's fitness but doesn't significantly improve the maximum amount of blood that the heart can pump.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*  
William J. Evans, (617) 556-3075

**Another reason for adding fruits and vegetables to your diet**—they might help delay cataracts. In a dietary survey of 112 Boston-area men and women between 40 and 70 years old, those who daily ate less than 1.5 servings of fruit or fruit juice, or less than 2 servings of vegetables or vegetable juice were 3.5 times more likely to have cataracts. And, those who ate less than 3.5 servings daily of both fruit



and vegetables were 5.7 times more likely to have cataracts. This is the first indication of a relationship between eating fruits and vegetables and the onset of cataracts. Further research is needed to clearly establish the findings.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Paul F. Jacques, (617) 556-3322*

**A diet high in fructose sugar and lacking in copper** caused major cardiovascular damage in pigs. Numerous studies with rats have produced similar results. But the findings with pigs are significant for two reasons: The fructose content was only twice the level in the average U.S. diet, which is generally low in copper. And pigs have a cardiovascular system very similar to humans. After 10 weeks on the copper-deficient diet containing 20 percent of calories as fructose, the pigs' hearts were twice the size of the other test groups. The animals were also anemic and had enlarged livers and low levels of copper-containing enzymes—including one that prevents aneurysms in blood vessels. The diets of the other test groups contained either adequate copper or glucose instead of fructose—the two sugars are metabolized differently—or adequate copper and glucose.

*Carbohydrate Nutrition Lab, Beltsville Human Nutrition  
Research Center, Beltsville, MD  
Daniel J. Scholfeld, (301) 344-2385*

**A diet lacking vitamin B<sub>6</sub>** produced a sharp increase in the serum insulin level of 4 men in their 60's. Though the number of people tested was small, the results are noteworthy because elevated serum insulin can be an early warning sign of diabetes. It indicates the hormone has become less efficient at processing glucose from a meal. During the study, the 4 men's fasting serum insulin levels climbed 131 percent after less than 3 weeks of eating a diet virtually devoid of the vitamin. But the four women in the study showed no significant increase. The men also had a slight increase in serum glucose. As B<sub>6</sub> was added back to the diet gradually over 2 months, the men's insulin levels dropped but did not return to starting levels. Additional research is needed before any conclusions can be reached on whether a B<sub>6</sub> deficiency promotes diabetes.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Judy D. Ribaya-Mercado, (617) 556-3128*

**A state-of-the-art method for measuring trace elements** in foods is producing significant differences in some values listed in USDA's Food Composition Tables (Handbook 8). These tables have been used for years by dietitians and researchers to estimate nutrient intake. But the values for some elements, such as copper and iron, include data from analyses done more than 40 years ago using now outdated analytical methods. Recently, ARS researchers used plasma emission spectroscopy to measure 9 trace elements in 15 foods covering the major food groups. Most of the values compared well with the tables. Copper and manganese levels disagreed most often, probably because older methods could not detect the very low concentrations found in many foods. For example, canned peaches had twice the level of copper stated in the tables, while whole wheat bread had 20 percent less. But whole wheat bread scored nearly 30 percent higher in iron, apparently due to iron fortification. The research also provided values where there were none before, such as the manganese content of dairy products, whole wheat bread and canned pineapple.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
David B. Milne/Rodger Sims, (701) 795-8424/8425*

**A device many health clubs, gyms, nutrition clinics and research labs use to quickly and easily measure bodyfat** is now more precise, thanks to experiments by ARS scientists and colleagues nationwide. ARS researchers rely on this device, and other approaches to measuring bodyfat, to find healthful bodyfat levels for Americans of different ages, bone structures and ethnic groups. Bodyfat measurements may be a better indicator of health than body weight is. Agency scientists and co-investigators at three other labs measured more than 1,500 volunteers from the East and West Coasts, using both the portable, commercially developed device—known as an impedance meter—and underwater weighing, an older, well-established approach. Data from those tests enabled scientists to increase the meter's accuracy so that readings now more closely agree with those from the slow, cumbersome and often uncomfortable underwater weighing. The meters measure the electrical resistance that occurs when bodyfat—a poor conductor of electricity—impedes a harmless, low-level current sent from electrodes placed on hands and feet.

*Bioenergetics Research, Western Human Nutrition  
Research Center, San Francisco, CA  
Marta D. Van Loan, (415) 556-5729*

## Crop Production and Protection

Careless application of nitrogen fertilizer hurts not only rice yields, but also crop quality. In field tests comparing different rates and timing for applying nitrogen fertilizer, researchers discovered that some rice varieties may have many more broken kernels at harvest if portions of the field accidentally are skipped in nitrogen application. Farmers are paid only half as much for rice with a large number of broken kernels. The higher incidence of broken kernels occurs particularly in rice varieties requiring high levels of nitrogen. This would include the popular semi-dwarf variety Lemont. In the field tests, some rice plants received all of their required nitrogen fertilizer in one treatment, some received the same total amount in three equal doses during the growing season, others received theirs in six smaller doses through the growing season, and some received no nitrogen at all. Rice from the unfertilized plants had twice as many broken kernels at milling than the same variety of rice that received all of its nitrogen fertilizer in one treatment. The findings highlight the importance of careful nitrogen application, particularly when the fertilizer is applied by airplane.

*Rice Production and Weed Control Research,  
Stuttgart, AR*

*Robert H. Dilday, (501) 673-2661*

Some wild Asian relatives of the soybean may help the crop survive salt stress in this country. *Glycine max* (the scientific name for soybeans) has ancestors that survive in salty water and soil. Such conditions can damage and even kill the domestic bean by interfering with plant metabolism. Scientists say wild relatives of *G. max*, such as *Glycine tabacina*, *G. clandestina* and *G. tomentella*, keep salt from invading plant shoots. If breeders can get these plants to give *G. max* the genes responsible for this salt-repelling ability, they could give growers new soybean varieties with more salt tolerance. That could expand by millions of acres the growing area for the U.S. soybean crop, whose \$10 billion annual value now is a close second to corn's. Current domestic varieties cope with salt—not always successfully—by channeling it to old leaves whose best days of photosynthesis are behind them.

*U.S. Salinity Lab, Riverside, CA*

*Michael C. Shannon, (714) 369-4834*

A 12-year study confirms that corn yields can increase when farmers rotate crops and carefully select tillage methods so they get the most from fertilizer. Researchers compared two systems—a corn-soybean rotation using 154 pounds of nitrogen fertilizer per acre versus continuous corn receiving 184 pounds of nitrogen fertilizer per acre. Results: Rotated corn produced 15 more bushels per acre than continuous corn. Rotated corn produced 69 pounds of grain in 1989 for each pound of nitrogen accumulated in the above-ground plant tissue. Continuous corn produced only 50 pounds. As to tillage practice, the study showed phosphorus was more evenly distributed in moldboard-plowed soil than in soil farmed by no-till or reduced tillage.

*Soil Tillth Research, Ames, IA*

*Douglas L. Karlen, (515) 294-3336*

Genes from spinach, altered in the lab and then inserted into a cousin of the mustard plant, could strengthen the “muscles” the plant uses to make its own food. The “muscles” are chloroplasts—leaf cell bodies that use sunlight and dozens of enzymes to crank out sugars from carbon dioxide and water. The research could ultimately lead to crops with a built-in capacity for greater photosynthesis and thus higher yields. In earlier studies in test tubes, the new genes produced a more potent form of activase, a crucial protein in photosynthesis. Discovered at ARS just 6 years ago, activase governs rubisco, an enzyme that captures carbon dioxide from the atmosphere and attaches carbon to the “skeleton” of what will become a sugar, or carbohydrate, molecule. Now, in another a scientific first, researchers inserted the modified genes from spinach into the mustard relative, known as *Arabidopsis thaliana*. If offspring from the modified *Arabidopsis* plants perform photosynthesis more efficiently with their new spinach genes, researchers will test the approach on a crop plant, probably soybean.

*Photosynthesis Research, Urbana, IL*

*William L. Ogren, (217) 244-3267*

Three new high-yielding, disease-resistant pecan varieties are making their debut in southern U.S. tree nurseries. Nuts from the variety, Osage, mature early in the fall, when pre-holiday prices are highest. This also gives the tree time to replenish its nutrient reserves for flowering the next spring. The Oconee variety has excellent quality nuts. Trees of the Houma variety resist the fungal disease scab. That could boost Houma's popularity in states such as



Georgia, where pecan producers sometimes spray against scab as often as 10 times a year. Nurseries may be selling these varieties within 2 years.

*Pecan Genetics and Improvement Research,  
Somerville, TX*

*Tommy E. Thompson, (409) 272-1402*

**Glossy Huguenot wheat from Australia** succumbs to all known damaging races of stem rust. Yet it could help scientists sort out wheats that stand up to certain types of that disease. Glossy Huguenot grows well in areas of Australia where stem rust doesn't flourish, but it is not grown commercially in this country. To study this problem, ARS researchers have imported it for experimental crossbreeding with various wheats that have multiple genes for resistance. Typically durum wheats are richly endowed with resistance genes. But identifying which resistance genes could be bred into wheats to counter a specific rust race of emerging prevalence was difficult. Studies of the offspring from Glossy Huguenot crossbreeding could help identify the genes. Glossy Huguenot's vulnerability could also make it a good testing variety for determining which rust races pose the greatest threat to bread wheats.

*Cereal Rust Research, St. Paul, MN*

*Alan P. Roelfs, (612) 625-7295*

**Blueberry seedlings have been successfully infected** with several strains of the bacterium *Agrobacterium tumefaciens* as a first step toward genetically improving these plants. For example, to fruit properly, blueberry plants require a certain number of chilling hours. If this process could be genetically triggered instead of relying upon weather conditions, growers could obtain more consistent, higher quality production. Blueberries also are susceptible to many diseases, and their growth is restricted to certain soil types. Next step for researchers: To see if these characteristics could be genetically manipulated via *Agrobacterium*, which is commonly used to introduce desirable traits in other kinds of plants.

*Fruit Lab, Beltsville, MD*

*Lisa J. Rowland, (301) 344-4654*

**Root-knot nematodes may be the cause** when a willow tree blows down instead of bending to a wind. An ARS scientist found that root-knot nematodes can infest willow roots and stunt them. Such stunting, even when it happens only on one side, can leave a tree vulnerable to the wind. Most of the commonly planted landscape willows, includ-

ing the "weeping" willows, were found to be highly susceptible to nematode infestation. Nematodes had not previously been suspected as a possible villain when willows were blown down. The native black willow, while not commonly chosen for landscaping, was resistant to nematodes. It may be possible to create a nematode-resistant, landscape quality willow, but it would require a number of generations of cross-breeding to a black willow.

*National Arboretum, Washington, DC*

*Frank S. Santamour, Jr., (202) 475-4864*

**Chlorophyll production in weeds could be disrupted** by future herbicides, thanks to discoveries on how one group of weed-fighting chemicals works. Studies have shown that diphenyl ether herbicides inhibit an enzyme that helps weeds make chlorophyll. Consequently, one of the ingredients normally used by the enzyme in making chlorophyll begins to build up in the weed. This ingredient absorbs light and interacts with oxygen to produce a form of toxic oxygen that destroys the weed's cell membranes. Now that scientists know how the chlorophyll-producing process works, they can use that information to develop other herbicides that would hinder the process in weeds. More efficient herbicides would enable farmers to use smaller amounts of the chemicals, thereby reducing production costs and the danger of environmental pollution. The new understanding of chlorophyll production could also lead to techniques for stopping chlorophyll loss that can occur when a plant is under stress. Stressed plants become yellow because they are losing chlorophyll faster than they can make it.

*Southern Weed Science Lab, Stoneville, MS*

*Stephen O. Duke, (601) 686-2311*

**Chemical and bacterial measures used to preserve wet hay** may not be doing the job. Usually farmers prefer not to bale wet hay. But they will do so to reduce field losses, by adding propionic or other organic acid materials or bacterial inoculates, as preservatives. Researchers found these measures less effective than drying the hay in the field. Drying hay in the field has its risks; rain may damage the hay or excessive drying may increase leaf loss during baling. Propionic acid may be beneficial if used occasionally to avoid rain damage, but for routine use, the benefits are small relative to the cost. Studies showed the bacterial compounds used over the last 5 years are ineffective as a hay preservative.

*U.S. Dairy Forage Research Center, East Lansing, MI*

*C. Alan Rotz, (517) 353-1758*

## Soil, Water and Air

**Growing corn on raised beds** seems to make the most sense in the cold, poorly drained soils of the northern Corn Belt. A 5-year study in Ohio showed an average yield advantage of 12 percent for corn grown on raised beds, or ridges, compared with two other tillage methods. That's because ridge till improved both subsurface and surface drainage. Soil in conventional and no-till plots was so impervious that drainage wasn't always fast enough to keep the seedbed from getting too waterlogged for timely planting or warm enough for good germination. This was true even where a perforated drainage pipe lay 3 feet beneath the surface. Drainage was poorest in no-till plots where the unplowed residue from the previous crop slowed down evaporation. With ridge till, however, the residue is scalped off the seedbed and pushed into the furrow, increasing evaporation from the seedbed. Also, the raised beds provided surface drainage away from the seedbed.

*Soil Drainage Research, Columbus, OH*  
*Norman R. Fausey, (614) 292-9806*

**Fertilizer may not get used quickly by corn plants** if it's applied where the soil gets compacted by farm machinery. This increases the chances of nutrients being leached or washed away by rain to pollute lakes, rivers and groundwater. A 3-year study of compaction was carried out on two Iowa silty clay loam soils. Scientists found early-season roots less able to probe for nutrients between crop rows where wheels had run. Their conclusion: Fertilizer is least likely wasted if it is applied below the soil surface in bands away from wheel tracks. In a 5-year Minnesota study other scientists found that compaction cut corn yields in dry, cool years. In normal years, machinery-compaction of fertile soil did not hurt yields, but plant uptake of phosphorus and potassium was reduced up to 30 percent.

*Soil Tilth Research, Ames, IA*  
*Thomas C. Kasper, (515) 294-8873*  
*Soil & Water Management Research, St. Paul, MN*  
*Michael S. Dolan, (612) 625-9245*  
*Soil Management Research, Morris, MN*  
*Ward B. Voorhees, (612) 589-3411*

**Lime applications on no-till acres** make life easier for soil microbes and help farmers save fertilizer dollars. No-till land that's short on lime becomes very acidic after ammonia-based commercial fertilizer is applied. When soils are too acidic, natural soil microbes can't convert the ammonia nitrogen quickly enough to meet plant needs. Lime applications reduce soil acidity, so microbes can do their jobs better. Scientists found that in years when lime is applied, fertilizer-nitrogen requirements for a corn crop may be reduced by about 13 pounds per acre. Another study showed Corn Belt farmers reap enough nitrogen from a previous alfalfa crop and from the nitrogen in manure to reduce commercial nitrogen fertilizer needs by as much as 14 percent region wide. Giving credit for alfalfa and manure nitrogen could save farmers in the Midwest about \$100 million.

*Soil and Water Management Research, St. Paul, MN*  
*C. Edward Clapp, (612) 625-2767*  
*Plant Science Research, St. Paul, MN*  
*Michael P. Russelle, (612) 625-8145*

**Checking a corn plant's complexion**—for greenness—is one innovative way ARS scientists are monitoring the quality of groundwater and saving farmers money. For better precision, scientists confirm that a commercially developed chlorophyll meter, used to check nitrogen levels in rice, can work on other crops. That means farmers can use this hand-held meter to see how healthy the plant is at a given time, based on its greenness. (Greenness is related to the level of nitrogen in the plant.) Using the meter gives farmers the option of applying less nitrogen fertilizer at planting and perhaps adding more later if needed. Soil tests for nitrogen can take several days to weeks. As nitrogen applications are reduced, so is the risk of contaminating groundwater supplies with fertilizer leaching or runoff.

*Soil and Water Conservation Research, Lincoln, NE*  
*Jim S. Schepers, (402) 472-1513*



Worms are usually considered to be indicators of healthy soil. But their tiny tunnels can drain irrigation water away from where it's needed—at the far end of a dry furrow. Every drop channeled into the worm tunnels is that much less water delivered to the roots of plants. Worms can be repelled, an ARS scientist found, by adding low concentrations of aqueous ammonia—about 50 parts per million of nitrogen—to irrigation water. A study of 35 fields planted to beans, corn, sugarbeets or alfalfa in south-central Idaho showed that infiltration rates increased in about a third of the irrigations, because of worms piercing the furrows. That reduces the flow of water to plants. Farmers can also switch to sprinkler irrigation or practice minimum tillage techniques that help slow water infiltration rates so that water will flow to the end of furrows and cover entire fields.

*Soil and Water Management Research, Kimberly, ID*  
*Thomas J. Trout, (208) 423-5582*

## Animal Production and Protection

Some cattle can be extremely finicky eaters. They turn up their noses if green forage contains even a few dead, brown stems called "wolf plants." Just three dead stems placed in saucer-sized clumps of crested wheatgrass deterred cattle from feeding. That wasted up to 50 percent of available forage during spring and early summer grazing periods in an eastern Oregon study. The results suggest that ranchers should make sure cattle graze pastures thoroughly. Otherwise, the uneaten leaves and stems soon turn brown, causing cattle to avoid the plant entirely—even the new green growth. Researchers say another remedy might be to breed grass varieties with stems that readily break off when dry, so pastures will be less likely to harbor wolf plants. Future studies will look at how and why cattle's eating preferences vary with the seasons.

*Range and Meadow Forage Management Research,*  
*Burns, OR*

*David C. Ganskopp, (503) 573-2064*

They have no wool, but hair sheep from the Virgin Islands have strong resistance to nematodes, worms that cost U.S. sheep farmers \$45 million annually. By studying this resistance, scientists hope to develop methods to protect woolly breeds of U.S. sheep. In new studies to understand how the resistance operates, the scientists found that hair sheep had more immune cells in their fourth stomach (where the worms reside) than did Dorsets, a breed common in the eastern United States. Researchers believe the extra immune cells prevent the nematodes from invading the stomach lining—a step necessary for infection. In grazing tests last summer, Dorsets had to be medicated to prevent nematodes from killing them. The hair sheep did well without medication. Since nematodes of sheep and cattle are similar, the knowledge gained with the sheep studies could lead to controls for bovine nematodes—a \$300 million annual problem in the United States.

*Helminthic Diseases Lab, Beltsville, MD*  
*II. Ray Gamble, (301) 344-1770*

An Arctic strain of bacteria could turn sainfoin, a Mediterranean legume, into a forage hit among Western cattle producers. In addition to tolerating heat, cold and drought, sainfoin doesn't cause bloat, a potentially deadly reaction livestock can have when eating legumes. But sainfoin sometimes falls short of other legumes in fixing nitrogen into a self-made fertilizer. Typically, bacteria called *Rhizobia* are added to the soil to jumpstart legumes' nitrogen fixation. Commercially available bacterial strains haven't worked well on sainfoin. But a strain discovered on an Arctic bacteria-collecting trip has done the trick in greenhouse studies. Sainfoin field tests are under way. If the bacteria work, sainfoin could fill an important niche in grazing schedules from March to June, well ahead of other warm-season forages.

*Forage and Livestock Research Lab, El Reno, OK  
Daniel P. Mowrey, (405) 262-5291*

Specially bred miniature pigs may provide the answer to producing trichinosis-free pork. ARS scientists found that one strain of these special pigs destroyed the cysts that serve as a host to the trichina parasite. That happened after the pigs were experimentally infected twice with trichinosis. Scientists are not sure why this happened in only one of the three strains of miniature pigs used in the study, but they believe the second round of infection may have triggered the pigs' immune systems to eliminate the parasites. The results suggest it may be possible to breed pigs that, when stimulated, will flush the parasite from their systems. If successful, such an approach might also keep pigs free from other cyst-forming parasites. Pigs become infected with the microscopic-sized trichina worm usually from eating improperly cooked garbage or uncooked meat scraps. The parasite can be passed along in the meat to people, if they fail to cook pork to at least an internal temperature above 138 degrees F. Freezing pork for 2 to 3 weeks can also kill the parasite.

*Helminthic Diseases Lab, Beltsville, MD  
Joan K. Lunney, (301) 344-1768*

## Scientific Information Systems

An 11,000-acre south Texas cattle ranch has been "video-mapped" to track down false broomweed—nicknamed the Beast because nothing seems to kill it. It returns despite chemicals, burning and mechanical measures. Cattle won't eat it and it chokes out the native forage. Recently, an ARS-developed airborne video system was used for the first time to video-map an entire ranch to calculate the extent of the weed. Images, taken by three video cameras in a small plane, were fed into four Super-VHS recorders (the fourth recorder receives a composite image). After the scientists videotaped the ranch from about 10,000 feet, they used a computer and image-processing software to figure out the weed had invaded 8.4 percent of the ranch—924 acres. Results of the test, which was the toughest yet faced by the system, may help the ranchers direct aerial applicators of weed-killing chemicals. While airborne video won't completely replace aerial photography and satellite data, it could quickly supply information on many different weeds and plant diseases, salinity, soil moisture, crop vigor and other conditions including plant stress due to pollution.

*Remote Sensing Research, Weslaco, TX  
James H. Everitt, (512) 968-5533*

Farmers and homeowners can reduce water pollution while maintaining good crop yields with the aid of a computer software package designed by ARS researchers. Called NLEAP—Nitrate Leaching and Economic Analysis Package—it is designed to help farmers and homeowners make decisions about fertilizing practices that will minimize the potential for nitrate leaching. Nitrogen in the form of nitrate is the major agricultural contaminant of groundwater. NLEAP can be used on a personal computer. Users can tap into local and state soil and climate data. It also includes optional national soil and climate information. The software and a book, "Nitrogen Management for Groundwater Quality and Farm Profitability," will soon be made available through the Soil Science Society of America.

*Crops Research Lab, Fort Collins, CO  
Marvin J. Shaffer, (303) 484-8777*

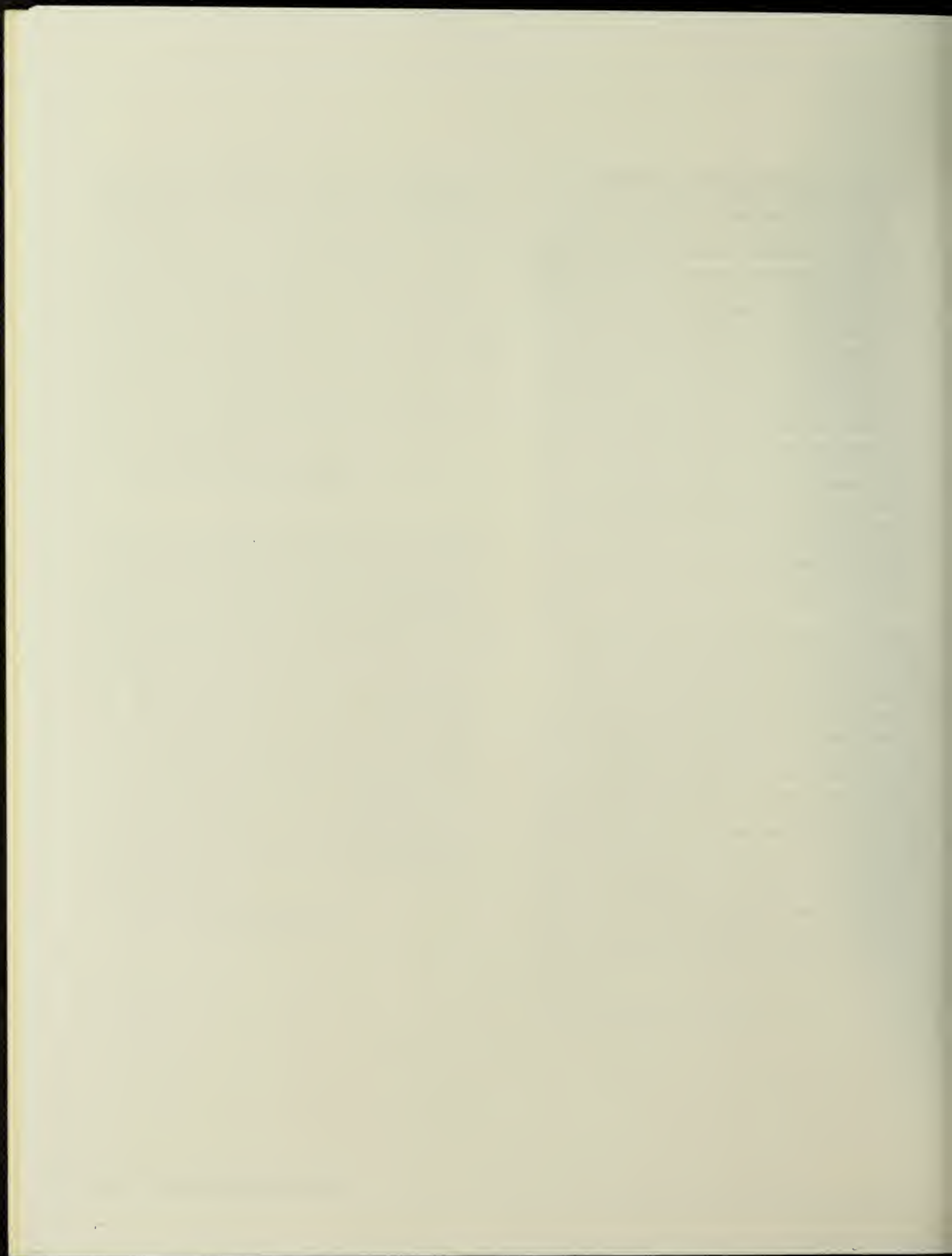


**Another new computer-based model provides fast estimates of fumigant residues** in cherries, apples and other fruits and nuts being prepared for export. It saves days of waiting for lab measurements of methyl bromide residues in produce samples. And regulatory officials could use the model's data to ensure that methyl bromide residues stay within limits set by importing countries. Methyl bromide, an odorless gas, kills eggs and larvae of the codling moth and other pest stowaways in produce at the packing plant. Currently, workers remove fruits or nuts from fumigation chambers when methyl bromide concentrations in the air fall to 20 parts per million. Excess residues in the fruit may be trapped when the produce is wrapped. These residues can seep out later. But now the model can estimate how much methyl bromide remains in the produce. It measures the amount of fumigant in exhaust air blown from the chambers and takes into account the type, number and size of fruit or nuts. Actual residue measurements in cherries, apples and walnuts validated the model's accuracy. (PATENT)

*Fruit and Vegetable Insect Research, Yakima, WA*  
*Charles R. Sell, (509) 575-5967*

**Computers can now forecast** each stage in processing food, from raw material to end product. Being able to predict interactions that occur among individual processing steps can help processors improve product quality, yield and nutritional value. Developed by ARS scientists, this new computer program mimics what happens on food processing lines. It uses mathematical calculations to determine proper on-line processing conditions such as cooking, blanching and drum drying. Taken into account are factors like the make up of raw material, temperature and the amount of material processed at a given time. ARS has had inquiries on this technology from at least 100 companies.

*Engineering Science Research, Philadelphia, PA*  
*Michael F. Kozempel, (215) 233-6588*





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# Quarterly Report of Selected Research Projects

January 1 to March 30, 1991

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## New and Improved Products

A new ink for newspapers and some magazines that won't rub off on your hands can be made from 100-percent soybean oil. ARS researchers have developed and patented formulas for black and color soy inks that are cleaner and cost less to make than inks now used in lithographic and letterpress printing. The good news for farmers: Total conversion of newspaper publishing to 100-percent soy ink would consume the oil from 40 million bushels of soybeans. The ink is also a boon for the environment because its lack of petroleum-based resins avoids disposal problems. (PATENT)

*Oil Chemical Research, National Center for Agricultural Utilization Research, Peoria, IL*  
*Sevim Erhan/Marvin Bagby, (309) 685-4011*

## Printed With 40 Percent Soy Ink

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

New yarns of 65 percent cotton and 35 percent synthetic fiber are just as strong as today's 35 percent cotton/65 percent synthetic blends. And they produce more comfortable and absorbant fabrics that don't pill as a result of a unique spinning process developed by ARS scientists. Pilling occurs in yarns made from conventional, randomly mixed fiber blends because the stronger, synthetic fibers don't wear down like cotton fibers and eventually project from the surface of yarns. To make a strong yarn, industry now blends a higher percentage of regular-strength synthetic fiber with cotton fiber. That's done before the yarn-spinning operation. The new process eliminates the traditional blending step. Instead, separate bobbins, called rovings, of pure cotton and synthetic fiber are now prepared and spun into composite yarn on a modified ring-spinning system. The stronger synthetic fiber in the yarn is surrounded with an even layer of 100 percent cotton fiber. For cotton farmers, this is good news because the new spinning procedure would use more cotton fiber to make these new yarns. (PATENT)

*Fiber Quality Research, Southern Regional Research Center, New Orleans, LA*  
*A. Paul S. Sawhney, (504) 286-4568*

Brown rice could become a common staple instead of a specialty item. A process being patented by ARS extends the shelf life of properly packaged brown rice. Usually brown rice turns rancid after being stored about 6 months. That's changed by the new process, which doesn't alter the appearance or texture of the cooked product, nor does it remove valuable nutrients as heat treatments often do. Unlike white rice, brown rice is rich in dietary fiber, minerals and vitamins—particularly the B vitamins—because the bran, or outer brown layer, is not milled away. The bran oil is easily degraded by lipase enzymes into free fatty acids, leading to off-odors and off-flavors. ARS scientists found that treating brown rice with ethanol deactivates lipase enzymes in the bran, halting free fatty acid formation. (PATENT)

*Food Systems Research, Southern Regional Research Center, New Orleans, LA*  
*Elaine T. Champagne, (504) 286-4333*

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**A new mini garbanzo with a nutty, peppery flavor** might become a tasty alternative to larger, milder-flavored garbanzos, common in salad bars. Also known as chickpeas, garbanzos are dietary staples in India and other countries on the Indian subcontinent. The new variety was named Sarah because a similar-sounding Turkish word, pronounced sari, means yellow, the color of the internal part of the chickpea seed. The new Sarah variety tolerates a serious fungal disease, known as chickpea blight, that has devastated garbanzo plantings in the Pacific Northwest in previous years. Besides serving the small, specialty domestic market that now relies on imports, Sarah may find a niche in the export market as well. To meet U.S. consumer preferences, researchers are now trying to breed a larger, blight-resistant bean.

*Grain Legume Genetics and Physiology Research,  
Pullman, WA  
Frederick J. Muehlbauer, (509) 335-9521*

**A simple, experimental automatic bagger for apples** minimizes the chances of bruising the fruit when it's packed for grocers' shelves. Bruise damage is a primary cause of quality and grade loss of fresh market apples. But the new equipment decreases bruises 15-fold by allowing the apples to settle, instead of dropping, into a bag. USDA Extra Fancy grade allows no more than one bruise, 1/2 inch in diameter, per apple. Operated under commercial conditions at a packinghouse, the experimental equipment bagged all apples at nearly the U.S. Extra Fancy grade. (PATENT)

*Fruit and Vegetable Harvesting Research,  
East Lansing, MI  
Dale E. Marshall, (517) 353-5201*

**ARS scientists are recommending a potential alternative crop** in the Southeast—Oriental persimmons. Known to be high in fiber and vitamins A and C, new research shows the fruit to have about three times as much vitamin C as citrus. It can provide 363 percent of the recommended daily intake of vitamin C. Usually grown in temperate to subtropical climates, the Oriental persimmon is now being grown as far north as central Georgia. Almost disease- and insect-free, it requires no more, maybe even less, care than other crops. Oriental persimmons are not to be confused with the smaller, seedier, American type that grows wild in the South and is so puckery.

*Southeastern Fruit and Tree Nut Research Lab,  
Byron, GA  
Jerry A. Payne, (912) 956-5656*

**Freshly peeled carrots can be free of the white film** that might otherwise mask their bright orange color. An ARS researcher says food processors can dip the peeled, ready-to-eat vegetables in a heated bath of water and citric acid for 30 seconds and then quickly dunk them into cold water. Refrigerated carrots will keep their attractive color up to 10 times longer if given the dip as soon as they've left the abrasion peeler—a processing device that rubs off carrots' skin. The technique won't affect taste; it's simple, fast, inexpensive and leaves carrots additive-free. Enzymes such as phenylalanine ammonia lyase likely cause the whitening. The heated citric acid stops the enzymes from forming. Citric acid is approved for food use. One U.S. food processor is already experimenting with the technique.

*Process Chemistry and Engineering Research,  
Western Regional Research Center, Albany, CA  
Harold R. Bolin, (415) 559-5863*

**A new natural biosoap kills sweetpotato whitefly nymphs**, a pest that devastates vegetable, cotton and ornamental crops worldwide. Chemical controls are not always effective due to insect resistance. Similar to commercially available soaplike products now used in greenhouses, the biosoap dissolves the waxy cuticle of the pest. The new product is made of extracts from a species of greenhouse-grown *Nicotiana*, a relative of the tobacco plant. The extract, having its own wetting agent, can be mixed with water and sprayed on plants.

*Florist and Nursery Crops Lab, Beltsville, MD  
John W. Neall/Jo Ann Bentz, (301) 344-4559*

**A new use for neem seed oil** has been found by ARS scientists working with W.R. Grace and Company. They're using it to control rust on beans and snapdragons as well as powdery mildew on numerous ornamentals. Neem seed extracts already are being used as a botanical insecticide. But this is the first time the oil has been used successfully against fungal plant pathogens. Scientists are looking for other natural products from the tropical neem tree that may reduce dependency on synthetic pesticides. (PATENT)

*Florist and Nursery Crops Lab, Beltsville, MD  
James C. Locke, (301) 344-2413*



New, high-tech probes could pinpoint residues of certain drugs in meat and poultry more quickly than current tests. Called monoclonal antibodies, the experimental probes might someday speed federal safety testing of meat and poultry. The antibodies seek and bind to residues of veterinary drugs called benzimidazoles. Farmers and ranchers rely on these drugs to protect cattle, sheep, pigs, chickens and goats from parasitic worms that damage the animals' lungs, liver or gastrointestinal tract. ARS scientists already have prepared probes to detect four benzimidazoles, and aim to produce antibodies to four additional ones this year. Federal food safety chemists check thousands of meat and poultry samples each year for benzimidazole residues. (PATENT)

*Food Safety Research, Western Regional  
Research Center, Albany, CA  
David L. Brandon, (415) 559-5783*

Giving wheat kernels a close shave makes it easier for breeders to correctly classify promising new varieties as "hard" or "soft." That's important, because the designation dictates the wheats' marketing use and the price it commands at the farm and the mill. While hard wheats tend to be best for breadmaking, soft wheats make the best flours for cakes and pastries. But accurate classification can be difficult, especially if a variety has both hard and soft parentage. ARS has developed a technique for checking hardness that relies on an automated, high-precision knife, called a microtome. The knife shaves off kernel slices about 2 microns thick: That's 30 times finer than a human hair. Under a microscope, slices from a hard wheat's kernel appear sturdy, pliable and intact. But soft wheat slices crumble into a tiny pile of powder. Unlike some approaches, this test leaves most of the kernel undamaged so that it can be planted. That's a boon to breeders who need every available kernel from an experimental wheat. The microtome technique proved as accurate as better-known procedures in preliminary tests with kernels supplied by ARS wheat labs in Ohio, Kansas, North Dakota and Washington. (PATENT)

*Food Quality Research, Western Regional  
Research Center, Albany, CA  
Gregory M. Glenn, (415) 559-5677*

## Animal Production and Protection

Nearly 100 percent of *Salmonella* cells in processed poultry died when irradiated at the federally-approved level. ARS researchers found that 99.5 percent of *Salmonella* cells were killed at the minimum dose recommended by USDA's Food Safety and Inspection Service. At the maximum dosage set in May 1990 by the U.S. Food and Drug Administration, 99.99 percent of cells were killed. Irradiation would be done after poultry products are cleaned, processed and packaged at commercial plants. *Salmonella* is a widespread bacterium that can cause illness if foods such as fresh or frozen poultry are not properly handled, refrigerated and cooked. ARS studies on poultry irradiated at or below the FDA limit showed there is no loss of the vitamins riboflavin and niacin. Thiamine loss ranged from 2.9 percent to 8.6 percent. Chicken contributes about 0.9 percent of the thiamine, 2.16 percent of the riboflavin and 8.22 percent of the niacin consumed in the American diet.

*Food Safety Research, Eastern Regional  
Research Center, Philadelphia, PA  
Donald W. Thayer/Jay B. Fox, Jr., (215) 233-6582*

Inbreeding sheep with the hope of boosting lamb production can lead to sizable losses, according to a 10-year ARS study involving nearly 14,000 ewe and 16,000 lamb records. Inbreeding—the practice of mating animals with their relatives—can increase within the offspring the frequency of desirable genes, like those for high wool or lamb production, if they are already present in the parents. But frequencies of deleterious genes are increased similarly. Mating a ram with his daughter results in offspring that are 25 percent inbred. If female offspring from that cross then mate with the same ram, their offspring are even more inbred. Because of the concentration of deleterious genes, flocks with inbreeding levels of 25 percent eventually yield fewer and smaller lambs and produce less wool. For example, ranchers may lose \$17 to \$36 per ewe, based on current market values for lamb and wool, as inbreeding increases from 20 to 50 percent. The study, among the largest of its kind, documented fourteen different traits, such as reproduction rates, lamb survival rates, body weight, and wool and milk production.

*Range Sheep Production Efficiency Research,  
Dubois, ID  
S. Keith Ercanbrack, (208) 374-5306*

**Hot, dry climates don't bother three new grass varieties** that could provide summer grazing for livestock in the Northern Plains. Dacotah switchgrass, Bison big bluestem and Tomahawk Indiangrass are the results of collaborations between ARS scientists and USDA's Soil Conservation Service. These 3- to 5-foot tall bushy plants also offer camouflage, nesting materials and seeds to birds and other wildlife. In addition, Dacotah and Bison thrive on low-fertility soils, such as abandoned mine sites and roadsides. Their roots produce a dense sod to curb erosion.

*Forage Seed and Cereal Research, Corvallis, OR*  
*Reed E. Barker, (503) 757-4728*

**A virus that grows harmlessly in the lungs of pigs** may help provide an improved vaccine to protect pigs against transmissible gastroenteritis (TGE), a disease that kills newborn pigs. The TGE and lung viruses are members of the same virus family. In experiments, pregnant sows were inoculated with the lung virus. After the sows gave birth, their piglets were given the potentially deadly TGE virus. The baby pigs developed diarrhea, but did not die. By comparison, 8 of 11 piglets from a sow not inoculated with the lung virus developed diarrhea and died after being given TGE. Checks for TGE virus are required for swine being sold for export. Commercially available vaccines against TGE are only marginally effective in giving protective immunity.

*Virology Research, Ames, IA*  
*Ronald D. Wesley, (515) 239-8305*

**Feeding more soybean meal to farm-raised shrimp** could keep the crustaceans well-nourished and trim production costs. Feed is shrimp farming's biggest expense. Soybean meal, rich in protein, is typically cheaper than other high-protein animal meals added to shrimp feeds, such as fish meal made from coarsely ground anchovy or tuna. ARS scientists in Hawaii showed that young *Penaeus vannamei*, a popular shrimp, thrive on pelleted feed that contains 30 percent soybean meal. Researchers estimate that's about twice the level of soy in a typical shrimp feed. Their finding agrees with earlier experiments conducted elsewhere by other researchers. Adding too much soy to feeds, however, may reduce its palatability. When feed pellets contained more than 42 percent soybean meal, shrimp ate less and gained less weight than shrimp on lower-soy rations.

*Tropical Aquaculture Research, Kaneohe, HI*  
*Chhorn E. Lim, (808) 247-6631*

**Two proteins have been found in Africanized honey bees** that could be the basis for a precise field test to distinguish them from domestic honey bees. While Africanized honey bees are more defensive than domestic honey bees, stinging in greater numbers and with less provocation, the two cannot easily be distinguished. Current identification tests require special training and lab equipment. A field test based on the presence or absence of the two proteins could be designed so it would not require any lab equipment beyond the test kit itself. Such a kit would be useful to beekeepers, apiary inspectors and researchers by providing identifications within a short period of time. USDA continues to run trap lines on the Mexican border with Texas to monitor any crossing of the bees. Africanized honey bees are descendants of bees brought from Africa to Brazil in 1956 in hopes of breeding a honey bee better adapted to the South American tropics. The bees escaped in 1957 and their offspring spread north and south; the first migrating swarm of Africanized honey bees reached the United States in October 1990.

*Bee Research Lab, Beltsville, MD*  
*Akey C.F. Hung, (301) 344-1749*

**Natural bacteria from the rumen of sheep and cattle** might be used someday to cut livestock feeding costs. Researchers isolated a gene for xylanase from a strain of the bacterium *Bacterioides ruminicola* and inserted it into the chromosome of a different bacterium found in the human colon. This genetically modified organism was incubated with oat spelt xylan, part of the fiber portion of oats. As a result, the new organism broke down more than 40 percent of the xylan into more easily digested carbohydrates. The ultimate goal will be to introduce this or other genetically engineered organisms into a cow's rumen, hopefully boosting the animal's ability to get maximum nutritional benefits from feed.

*Fermentation Biochemistry, National Center for Agricultural Utilization Research, Peoria, IL*  
*Terence R. Whitehead, (309) 685-4011*



## **Human Nutrition**

**Loading up on carbohydrates** not only improves stamina during sustained, strenuous exercise such as long-distance running and cycling, it also cuts body losses of two important trace elements. Urinary losses of chromium and zinc are known to increase under stressful exercise. But when eight men doubled their carbohydrate intake 3 days before sustained exercise, their losses of chromium and zinc dropped an average 23 and 28 percent, respectively. Losses of potassium, magnesium and calcium were not altered. During the test, the men cycled ergometers submerged in 77 degree F water in 20-minute increments for a total of 160 minutes. Consuming the extra carbohydrates also helped them increase the amount of work they completed with less stress to the body, indicated by lower blood levels of the stress-hormone cortisol.

*Vitamin and Mineral Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD  
Richard A. Anderson, (301) 344-2091*

**Evidence that smoking can accelerate bone loss** comes from a 2-year study of 312 women past menopause. Researchers measured the women's bone density at four sites—the forearm, hip, spine and heel—at the beginning, middle and end of the study. All 312 women, who were between the ages of 40 and 70, began the study with about the same bone density. But the 34 smokers lost significantly more bone in the forearm—averaging nearly 1 percent per year compared with no loss for the 278 non-smokers. Bone loss in the hip and spine was also higher in the smokers but did not reach statistical significance. Smokers also retained less calcium from a supplement, suggesting that they absorbed less of the mineral to begin with. This could account for their higher bone loss. The negative effect of smoking on bone density is far less than the loss of estrogen, a low calcium intake or the lack of physical activity, which could explain why earlier studies have yielded mixed findings. This study is the first to show that smoking can increase bone loss—at least in some bones—in older women.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Elizabeth Krall, (617) 556-3074*

**A study of 211 women offers new evidence that taking estrogen** after menopause improves a woman's blood cholesterol profile, possibly reducing her risk of heart disease. The women had undergone natural menopause or had earlier had their ovaries surgically removed. Estrogen users in the natural menopause group had a significantly higher ratio of the "good" HDL (high-density lipoprotein) cholesterol to the "bad" LDL (low-density lipoprotein). That's important because HDL removes cholesterol from arteries and is critical in reducing risk. Estrogen users in this group also had significantly lower total cholesterol, LDL and fat-rich VLDL (very-low-density lipoprotein) particles than the non-users. Although HDL levels were not significantly higher with estrogen, the protein associated with HDL—probably a better measure of this particle—was. On the other hand, women who used estrogen and had had their ovaries surgically removed had significantly higher levels of HDL and its protein, but the differences in total cholesterol, LDL and VLDL cholesterol were not significant. The study was funded in part by the National Heart, Lung and Blood Institute.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Ernst J. Schaefer, (617) 556-3100  
Donner Laboratories, University of California, Berkeley, CA  
Hannia Campos, (415) 486-6346*

**When we age, it takes longer** for the fat we eat to move out of the bloodstream and into cells, a new study shows. This explains why, in an earlier study, older people had significantly more fat circulating in their blood after eating a fat-rich meal than did younger people. The findings give senior citizens one more reason to restrict their fat intake: Elevated triglycerides—as fats are called—potentially lead to plaque buildup and thus contribute to the risk of heart disease. Researchers compared the time it took a group of men and women over 60 to clear dietary fat from their blood with another group under 30. Fat clearance took nearly twice as long in the older group.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Ernst J. Schaefer, (617) 556-3100*

**Polyunsaturated fats**—such as those in vegetable oils—got a clean bill of health when ARS scientists examined their effects on the human immune system. This finding came from an 80-day experiment with eight volunteers. It differed from results of earlier studies with mice and rats, in which these fats suppressed the animals' immune systems. Those results raised concerns because some nutrition experts have urged that polyunsaturates make up one-third of total fat in meals. The new ARS findings, however, suggest that the immune system is not suppressed when a balanced, low-fat diet includes a level of polyunsaturates high enough to give cardiovascular benefits. Further, the volunteers' regimen actually bolstered their immune systems. Total fat intake was held to 25 percent of each day's calories. Immune response improved whether polyunsaturates were low (3.5 percent of the day's total calories) or moderately high (13 percent) in the daily plan of balanced meals. To measure immune response, researchers monitored activity of disease-fighting white blood cells collected from blood samples. Further experiments are planned to confirm the findings.

*Bioenergetics Research, Western Human  
Nutrition Research Center, San Francisco, CA  
Darshan S. Kelley, (415) 556-4381*

**An amino acid is emerging as another risk factor for heart disease.** Findings from a large-scale study corroborate earlier reports that elevated blood levels of the amino acid homocysteine is an independent risk factor—not related to cholesterol or fat levels. Homocysteine is the precursor of two amino acids that are used by the body to synthesize proteins. Researchers examined homocysteine levels in 170 men with premature (under age 60) coronary artery disease and a control group of 255. Twenty-eight percent of the men with clogged arteries had elevated levels versus 10 percent in the control group. And about half of the patients with clogged arteries—or 14 percent—were linked to a genetic abnormality. The other half may have been due to a deficiency in the B vitamins and folate, since high homocysteine can often be corrected with these supplements. The National Heart, Lung and Blood Institute partially funded the study.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Ernst J. Schaefer, (617) 556-3100  
Clinical Research Institute of Montreal, Canada  
Jacques J. Genest, (514) 987-5715*

**Copper-deficient diets that are high in sugar** may turn certain iron compounds stored in rats' livers into a toxic substance that can't be used. And this could have implications for people. The finding, from a series of studies, explains why young rats routinely developed severe anemia, organ damage and died prematurely from copper-deficient diets only when the main source of carbohydrate was sugar—specifically fructose sugar. When it was starch, there were no ill effects. Injecting these animals with red blood cells cleared up the anemia and prevented organ damage, indicating the animals could not use the iron they had stored in their livers. An assay of their livers showed much more of this iron was in the form of tissue-damaging free radicals than the animals fed starch instead of fructose. Finally, giving fructose-fed animals a drug to remove iron from their bodies prevented most of the damage, indicating their iron was indeed toxic. Whether this occurs in people has not been studied. But Americans typically consume less than the minimum suggested intake of copper, and our fructose intake is increasing. Also, high alcohol consumption may have the same effect as fructose because we metabolize the two substances similarly. Research shows the danger lies in eating too much refined fructose from table sugar—which is half fructose—and from high-fructose corn sweeteners, not in eating fruit and other fructose-containing plant foods.

*Carbohydrate Nutrition Lab, Beltsville Human  
Nutrition Research Center, Beltsville, MD  
Meira Fields, (301) 344-2417*

**We now better understand how dietary saturated fat and cholesterol** increase the undesirable LDL cholesterol circulating in the blood. It hinges on the number and mobility of LDL receptors. The receptor—a sort of tugboat—attaches to LDL cholesterol at the surface of liver cells, ushers the fat globule inside to be broken down and returns for another globule. Researchers fed Cebus monkeys diets in which 30 percent of the calories were either corn oil or the more saturated coconut oil. Both saturated fat and cholesterol had two effects on the receptors: They reduced receptor numbers by suppressing the gene that initiates their production and slowed receptor movement through the cell membrane by reducing membrane fluidity. Diets high in saturated fat lead to less fluid membranes than unsaturated fat. Consequently, the receptor makes fewer round trips and removes less LDL cholesterol from the blood. Saturated fat alone depressed LDL receptors more than cholesterol alone, and the combined effects were additive.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Jose M. Ordovas, (617) 556-3102*



## **Crop Production and Protection**

Scientists are now freezing apple buds in a series of long-term experiments as an alternative to growing several trees of each apple variety to preserve genetic specimens. The latter is too expensive in terms of land and labor. Now, the backup specimens can be stored in a deep freeze. Buds are taken from trees during winter dormancy, dehydrated and then stored in liquid nitrogen. Harvesting buds in December rather than later in the winter seems to give better storage results. Viability after cryogenic storage has been mixed—from 100 percent for some varieties to as low as 10 percent with others. On the average about 50 percent survive. A cold-hardy crabapple from Siberia, for example, had the best survival rate.

*National Germplasm Repository for Apple, Geneva, NY*  
Philip L. Forsline, (315) 787-2244

A 4-foot-tall, factory-reject broomstick promises boll weevils food and sex, but lures cotton's nastiest enemy to a surprise death. Weevils can either chew the "bait stick's" insecticide-laced cap, or land on the coated stick, and die shortly after. In tests in Mississippi and Texas cotton fields, scientists used 100 times less insecticide—only 1 gram per acre—to control the weevils. Normally several spray applications of organophosphate insecticide are needed to try to control them. So far, in the second year of tests in Mississippi, scientists found up to 70 percent fewer boll weevils. The bait stick costs only about \$1 to manufacture; it could be a viable alternative to control a pest that costs more than \$300 million annually in crop losses and chemical control. Both the weevil-killing cap and coating on the stick are patented. ARS has signed research and development agreements with two companies to improve the stick for commercial use. The bait stick idea possibly could be used for other insect pests on other crops in the future. (PATENT)

*Boll Weevil Research Lab, Starkville, MS*  
Gerald H. McKibben/James W. Smith, (601) 323-2230

Mixing the insecticide chlorpyrifos with a soybean oil solution, and then injecting the mixture into irrigation water makes it more effective for controlling corn earworms. When applied this way through center-pivot irrigation systems, the insecticide-oil mixture forms droplets in the spray water that stick to the corn leaves better. Field tests on sweet corn, done in cooperation with University of Georgia scientists, showed that three times more chlorpyrifos stayed on the corn leaves than when the standard water-soluble formula of the insecticide was injected. The chlorpyrifos broke down quickly after spraying—lasting only 4 days on foliage and 2 weeks on the soil surface. This method of applying insecticides is adaptable to many other insecticides and crops.

*Nematodes, Weeds and Crops, Tifton, GA*  
R. Don Wauchope, (912) 386-3892

A new sweet potato variety is white at maturity instead of the traditional orange and tastes much like a white Irish potato. The new variety is called Sumor—Old English for summer—because the variety has the typical sweet potato's liking for heat. Sumor could make an ideal substitute crop for climates too hot to grow Irish potatoes. While Sumors have only a fraction of the vitamin A found in regular sweet potatoes, they have more vitamin C than do most tomatoes, which qualifies it as a high-nutrition crop. Sumor sweet potatoes are commercially available from Foundation Seed Inc. at Clemson University.

*U.S. Vegetable Lab, Charleston, SC*  
Philip Dukes, (803) 556-0840

Pecan growers in the deep South often lose most of their crop when nuts sprout in their shells and begin to rot during the growing season. If growers try to rescue the nuts by harvesting and drying them early, this can significantly reduce kernel weight. Findings from a preliminary 2-year study suggest a better solution might be planting short-season northern pecan varieties among the southern varieties. The northern varieties are less prone to pre-harvest sprouting. Also, windborne pollen from compatible northern varieties might stimulate the southern trees to produce more nuts and larger kernels. Scientists artificially applied pollen from the northern variety Johnson to blossoms of several southern varieties. In some cases, the Johnson pollen reduced the incidence of early sprouting by half in a standard 30-day germination test.

*Pecan Genetics and Improvement Research,*  
*Somerville, TX*  
Tommy E. Thompson, (409) 272-1402

**Choosing the right color of mulch** will increase plant growth. Southern peas, for example, perform better with mulch that's red. When pea plants were grown using red mulch, the yield was 3.0 tons per acre. That's compared to 2.8 tons per acre with white and 2.7 tons per acre with conventional black. Two color components of light influenced the plant growth: The percentage of blue in the light and the ratio of far-red to red. Red mulch had the highest far-red to red ratio but a lower blue component. In previous experiments, researchers found tomatoes had the highest yield when grown using red mulch. (PATENT)

*Coastal Plains Research Center, Florence, SC*  
*Patrick Hunt, (803) 669-5203*

**Help may be on the way for Midwestern corn and soybean farmers** plagued by hemp dogbane, a perennial weed. If left unchecked, it's been known to cut corn yields by 15 percent, soybeans by 41 percent and sorghum by 45 percent. For years, producers have used intensive tillage and phenoxy herbicides to fight the weed. However, increasing interest in conservation tillage has sparked a search for alternatives to these traditional control methods. Now researchers have found a possible candidate. Just 57 grams per acre of the herbicide fluroxypyr, applied after the weed has emerged, knock out more than 80 percent of the weed during the first growing season; 65 to 75 percent of the survivors die the following year. In addition, the fluroxypyr is less harmful to crops than traditional herbicides. The use of fluroxypyr on hemp dogbane is still experimental in the United States, although the herbicide is approved for some uses in other parts of the world.

*Crop Protection Research, Urbana, IL*  
*Loyd M. Wax, (217) 333-4424*

**Purple loosestrife, a noxious weed** that is sometimes admired for its reddish-purple flowers, has become a target of ARS, Swiss and German scientists who are searching for a natural enemy to control it. Since being brought to North America in the early 1880's, purple loosestrife has invaded over 400,000 acres of wetlands in 25 northern states and parts of Canada, crowding out forage plants eaten by livestock and wildlife. Over \$45 million is lost annually on this weed. This includes cutting, mowing, burning or applying herbicide to keep it from spreading in marshes, irrigation and roadside ditches, wild and cultivated rice fields and in wildlife refuges. Three European beetles, natural enemies that attack the roots and leaves of purple loosestrife, are being tested in Switzerland and West Germany before they are brought to the United States as biological control agents. Scientists want to ensure that the weevil, *Hylobius transversovittatus*, and the leaf beetles, *Galerucella californiensis* and *G. pusilla*, will attack only purple loosestrife. Then, a generation of these insects will be reared under quarantine to make sure they have no parasites or diseases before they are tested at 15 sites in 7 states next summer. Those sites will be closely monitored before, during and after the insects are released to see if the beetles have become established and are controlling the purple loosestrife.

*Beneficial Insects Lab, Beltsville, MD*  
*Stephen Hight, (301) 344-1125*

**Test-tube cotton, grown without the plant,** may be just the tool needed for genetic engineers who want to develop cold-tolerant cotton plants with higher yields. A recent study shows that ovules—the reproductive stage of the cotton boll—grown indoors are just as good for temperature studies as the whole plant grown outdoors. Lab-raised cotton reacts to cold the same way plants in the field do: They stop growing at 59 degrees F. Lab fibers grown from ovules exposed to 12 hours of 59 degrees F took longer to emerge, grew slower and yielded less than those from ovules exposed to warmer nighttime temperatures. Working with lab-cultured ovules would speed up breeding selection because fibers can be grown year-round in a small space, without waiting for whole plants to grow.

*Cropping Systems Research Lab, Lubbock, TX*  
*Norma L. Trolinder, (806) 746-5353*



## Soil, Water and Air

Northwest farmers can meet erosion-control goals while avoiding the weedy curse that sometimes accompanies conservation tillage systems. These systems reduce erosion by leaving crop residues—like wheat stubble, barley straw and pea vines—on the fields after the harvest. While conventional tillage with a moldboard plow helps control weeds, it buries the soil-protecting residues. But a new 5-year study in eastern Washington shows how farmers can save soil and money by leaving crop residues on the ground, controlling weeds with herbicides and alternating crops annually. The most profitable systems were wheat-barley-pea rotations grown under conservation tillage with moderate or maximum weed control. The least profitable was continuous cropping of wheat grown under conventional tillage and minimum weed control. The findings should also help farmers comply with the 1985 Farm Bill. It requires farmers to have soil-saving practices in place by 1995 or face losing eligibility for USDA loans and other assistance programs.

*Nonirrigated Agriculture Weed Science Research,  
Pullman, WA  
Frank L. Young, (509) 335-1551*

Wind-powered water pumps can be modified to take full advantage of all the power in the wind when windspeeds range from 20 to 30 mph. Conventional windmills begin to slow down at windspeeds above 20 mph, thereby reducing the volume of water pumped. By inserting an oscillating lever into the piston rod, the pump stroke is made to automatically adjust to the windspeed. In recent tests, this modification resulted in a flow of 12 gallons of water per minute in 26 mph winds, compared to a maximum 7 gallons at high wind speeds with the conventional design.

*Conservation and Production Research Lab,  
Bushland, TX  
R. Nolan Clark, (806) 378-5734  
West Texas State University Alternative Energy Institute,  
Canyon, TX  
J.W. McCarty, (806) 656-2295*

Just the first 0.1 inch of rain washes off almost all of the pesticide that is going to wash off the leaves of treated plants. Neither the force with which the rain hits the leaves nor the time it takes for this amount of water to fall affects the wash-off rate, according to field tests of three insecticides. But, the amount that will wash away differs between classes of pesticides—because of their water solubility. Organochlorines are the least susceptible: Only about 2 percent is likely to be washed off by 0.1 inch of rain. Carbamates and organophosphates are the most likely to be cleaned off—as much as 50 percent. This wash-off data can be incorporated into studies of the environmental fate of pesticides into runoff and groundwater.

*Soil and Water Research Lab, Baton Rouge, LA  
Guye H. Willis, (504) 387-2783*

## Scientific Information Systems

**Ranchers can avoid overgrazing and still turn a profit** with a new ARS computer program, called RANGETEK. It estimates how much forage will likely be available on a particular range during the upcoming season. Taken into account are factors like the kind of soil, the type and amount of forage species and historical weather data. RANGETEK's forage estimate tells the rancher how many cattle can graze the site. Grazing too few cattle, where there's ample forage, can cut income. But grazing too many, or for too long a period, can thin out the best forage species and eventually degrade the land's long-term productivity. Overgrazed land is also more erodible. RANGETEK also can be used by land resource managers in the Department of the Interior's Bureau of Land Management and USDA's Forest Service, which control most of the publicly-owned land suitable for grazing. A free copy of RANGETEK, which runs on most IBM-compatible personal computers, can be obtained by mailing a blank 5-1/4 inch floppy disk to the researchers.

*Watershed Management Research, Boise, ID  
J. Ross Wight, (208) 334-1363*

**Wintertime aerial photographs** are giving researchers early clues about how well crops can stand the cold. Cereal crops—wheat, barley and rye—need snow cover to protect the crowns of the growing seedlings from bitter winter temperatures. As winter progresses, snow erosion occurs, leaving the crowns of some plants exposed to the elements. Researchers take weekly photographs of the wave-like patterns of snow erosion for several purposes. One is to compile environmental records of snow cover—or lack of it. Another is to understand patterns of plant loss that emerge in the spring. The photographic records also are used to find related plant species in which the most damaging form of stress is controlled and can be candidates for cold hardiness breeding.

*Sugarbeet, Bean and Cereal Research, East Lansing, MI  
C. Robert Olien, (517) 355-2233*







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# Quarterly Report of Selected Research Projects

United States  
Department of  
Agriculture



Agricultural  
Research  
Service

April 1 to June 30, 1991

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## New and Improved Products

**Microbes can convert starch** from corn, potatoes or small grains to lactic acid which may be used for making biodegradable plastics. Already a high-demand commodity used in food processing, lactic acid from starch could become a low-cost raw material for making plastics that are 100 percent biodegradable. An enzyme purified from the bacterium *Lactobacillus amylovorus* binds to and breaks down cornstarch granules, researchers found. When teamed with other enzymes from the same microbe, they can convert up to 95 percent of cornstarch to lactic acid. Currently, more than half of the approximately 25 million pounds of lactic acid used in the United States is imported.

*Biopolymer Research, National Center for Agricultural Utilization Research, Peoria, IL*

*Anthony Burgess-Cassler/Syed Imam, (309) 685-4011*

## Printed With 40 Percent Soy Ink

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

**Cotton may be used more extensively** in nonwoven fabrics, such as those found in surgical operating rooms and in disposable diapers. Cotton has only a 4 percent share of the market which is dominated by petroleum-based synthetics. But ARS is developing ways to use more cotton in these products. Cotton isn't widely used for nonwovens because it is slower to process and lacks the strength of synthetic fiber. Yet the textile industry is turning to cotton as consumers demand products that are natural, biodegradable and made from renewable resources. ARS scientists are working on thermal bonding techniques that will improve fabric properties of high-cotton blend fabrics and minimize the use of synthetic fibers. Other techniques could use barbed needles or water jets to prepare 100 percent cotton nonwovens. Products that could be made from cotton nonwovens include apparel fabrics, head rests, bibs, bed sheets, pillow slipcovers, towels and floppy disks covers.

*Textile Finishing Research,  
Southern Regional Research Center, New Orleans, LA  
Jerry P. Moreau, (504) 286-4331*

**New stone-finishing techniques for cotton fabrics** will make it easier for the textile industry to produce denim garments in a multitude of colors. Currently, color selection of a stone-washed or ice-washed garment is made before it becomes a garment, indeed, even before the fabric is woven. Blue and black are popular choices because they are more economical to produce on a large scale. The new stone-dyeing methods are based on ARS-patented processes that allow cotton to be dyed after a no-wrinkle finish is applied. This happens by injecting chemicals that either attract or repel dyes into porous volcanic rocks called pumice stones, which are used to make stone-washed and ice-washed garments. In one technique, a tumbler has stones soaked in chemicals that will ultimately make the areas touched by the stones acquire a positive charge. Then, these areas of the garment can be selectively dyed with dyes carrying a negative charge. (PATENT)

*Textile Finishing Chemistry Research,  
Southern Regional Research Center, New Orleans, LA  
Robert J. Harpe, (504) 286-4567*

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A new dyeing technique could offer consumers additional wrinkle-free garments while helping cotton textile and garment manufacturers cope with the changing fashion world. Currently, cotton fabric has to be dyed before a no-wrinkle finish is applied because the chemical bond created by the finishing process repels dyes. If the color goes out of fashion, however, the textile and garment industries are stuck with a lot of dyed wrinkle-free inventory. So they often opt for unfinished fabric, giving consumers a limited selection of wrinkle-free cotton garments. Now, a variety of quarternary ammonia salts, some of which are found in chicken feed and fabric softener, solves the problem.

Added to the no-wrinkle finish solution, the salts give the finished fabric a positive charge, which attracts dyes. ARS scientists found the technique also broadens the types of dyes that can be used on cotton and, in some cases, improves uptake of standard dyes, resulting in deeper hues. (PATENT)

*Textile Finishing Research,  
Southern Regional Research Center, New Orleans, LA  
Robert J. Harper, Jr./Eugene J. Blanchard/Robert M.  
Reinhardt, (504) 286-4521*

Researchers are getting more out of cornstarch—specifically, more of a compound called gamma-cyclodextrin—that might be used to encapsulate pharmaceuticals, pesticides, perfumes and cosmetics. Bacterial enzymes typically convert about 5 percent of cornstarch into cyclodextrins by first breaking it up and then reassembling it into doughnut-shaped molecules. But adding an inexpensive, nontoxic chemical called cyclododecanone to the mix can increase the cyclodextrin yield to about 50 percent. Cyclodextrins can mask undesirable flavors or odors and protectively shield drugs or nutrients from premature deterioration caused by oxygen. An estimated 2 million pounds of cyclodextrins now are marketed annually by Japanese firms. (PATENT)

*Biopolymer Research, National Center for Agricultural  
Utilization Research, Peoria, IL  
Jacob A. Rendleman Jr., (309) 685-4011*

Enzymes like those produced by the soil fungus *Trichoderma viride* may be used one day as a tool to both defend and kill plants. ARS scientists found that one enzyme, known as EIX, promotes ethylene production in some varieties of tobacco. Ethylene is a plant growth hormone that causes fruit to ripen and cells to age. The EIX enzyme rapidly induces ethylene, so researchers are

intrigued by its possible use as a natural herbicide. Another potential use: A tool to speed the screening of resistant traits against disease. Scientists are continuing research to fully understand EIX and its possible applications. Also, studies of the enzyme may lead to new understanding of ethylene production and control of postharvest losses of fruits and vegetables.

*Plant Hormone Lab, Beltsville, MD  
James D. Anderson/Rosannah Taylor/Bryan A. Bailey,  
(301) 344-3537*

The pressure inside tomato cells can affect how fast the fruit ripens. That's because pressure influences how fast a precursor chemical, ACC (1-aminocyclopropane-1 carboxylic acid) is transported to sites within the cell where ACC is converted into the ripening hormone, ethylene. Intermediate cell pressure induces more ethylene production and tends to ripen tomatoes faster than those with higher or lower pressure. Researchers are studying ways to manipulate cell pressure, ACC transport, or both, to control ethylene production. Too much ethylene, or producing it at the wrong time, causes overripening, leading to reduced quality, spoilage and an estimated loss of \$30 million per year in the United States. If cell pressure can be modified, the shelf life of various perishable produce can be extended, while at the same time keeping it firm enough to handle without bruising.

*Plant Hormone Lab, Beltsville, MD  
Robert A. Saffner, (301) 344-3672*

Natural compounds from spices and other sources may save millions of dollars worth of potatoes from premature sprouting. When potatoes sprout early, they soften and lose weight. Much of their starch turns to sugars that make french fries and potato chips turn an unattractive dark brown color when cooked. The natural sprouting inhibitors or slightly modified versions of them may become replacements for a synthetic inhibitor known as CIPC. ARS studies found the natural compounds can be applied to tubers to kill storage rot fungi and cause the tubers to live, breathe and manufacture sugars at lower than normal rates. When the potatoes are prepared for serving, the compounds are washed away or destroyed by cooking, leaving no unusual flavors. (PATENT)

*Bioactive Constituents Research, National Center for  
Agricultural Utilization Research, Peoria, IL  
Steven F. Vaughn, (309) 685-4011*



A natural chemical in fungi specifically changes the process which controls the calcium content within cells, ARS researchers found. That chemical—cyclopiazonic acid (CPA)—could become a tool for understanding how calcium is regulated inside skeletal and cardiac muscle. As calcium moves into and out of muscle cells, its precise regulation within cells is critical for the muscle to function properly—disruption of the regulation of calcium can cause some muscle diseases. CPA, a product of certain species of *Penicillium* and *Aspergillus* fungi, inhibits an enzyme responsible for calcium's regulation within muscle cells. CPA stops only calcium, so it is possible for new studies to zero in on whether the enzyme could be used to treat muscle diseases or in regulating the contraction and relaxation of skeletal and cardiac muscles. Such studies could lead to a model for a whole new class of medications designed to treat diseases involving a breakdown of calcium regulation in both humans and animals.

*Toxicology and Mycotoxin Research, Athens, GA*  
Ronald T. Riley, (404) 546-3377

The reason a small Southern fruit—the mayhaw—smells like an apple lies in nine aroma compounds that are similar in both fruits. ARS scientists have identified 16 compounds in the mayhaw, including the nine causing the apple-like aroma. Scientists have compiled information on these compounds so plant breeders might develop mayhaw varieties with desired levels of aroma-influencing compounds found in parent varieties. Yellow and red mayhaw varieties grow wild on thorny trees in swamps and shallow ponds in the southeastern United States and are similar in size to 1/2-inch cherry tomatoes.

*Food Quality Evaluation Research, Athens, GA*  
Glenn W. Chapman, Jr., (404) 546-3143

## Human Nutrition

An increase in calcium might ease the stress for women around menstrual time, a 5-1/2-month study suggests. Ten women reported significantly fewer undesirable symptoms associated with the menstrual cycle when they got 1,300 milligrams (mg) of calcium rather than 600 mg. U.S. women average a little more than 600 mg in their daily diets. Women in the study experienced fewer PMS-type mood changes, such as irritability, anxiety, crying and depression, while on the higher calcium intake. They also reported fewer negative changes in behavior and concentration, such as poorer work performance and overall efficiency, avoiding social contacts, forgetfulness, confusion and accidents. And the extra calcium significantly reduced complaints of physical distress, such as headache, backache and cramps during menstruation.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND*  
James G. Penland, (701) 795-8471

Americans may be consuming substantially more calories than nutrition surveys show, according to an analysis of 12 long-term studies. The 266 volunteers—from 21 to 64 years old—reported consuming an average 18 percent fewer calories on food intake records prior to the studies than they actually needed to maintain weight during the studies. There was no difference in reporting based on the volunteers' gender, age or weight. Eighty-one percent underreported their food intake, 8 percent overreported and 11 percent were accurate to within 100 calories. If substantiated in larger studies, the findings have far reaching implications: The vast majority of food and nutrient intake data comes from individuals recalling or recording what they ate. These data are used by federal agencies to judge the nutritional status of the U.S. population and identify low intakes of vitamins or minerals. A higher food intake could mean that the "problem nutrients"—such as vitamin B6, zinc, magnesium and iron for women—are not such a problem. It could also explain why average body weight of the U.S. population increased between the late 1960's and late 1970's while reported food intake went down.

*Beltsville Human Nutrition Research Center, Beltsville,  
MD*  
Walter Mertz, (301) 344-2157

**Adding more fiber-rich foods to your diet replaces the high-calorie foods you might otherwise eat.** A new study shows it also slightly reduces the absorption of the calories you do eat. The method used to calculate the number of calories people actually get from foods—known as metabolizable energy—was developed around the turn of the century, when eating habits were quite different. Because of the current emphasis on increasing dietary fiber and decreasing fat, researchers are checking the method's validity by direct measurement. In a 10-week study, 42 men alternated between eating a typical U.S. diet—with 34 grams of total fiber per day and 36 percent of calories from fat—and a diet with twice the fiber and half the fat. During the high-fiber period, about 4 percent more of the calories the men consumed passed through the gastrointestinal tract unabsorbed. Metabolizable energy from the high-fiber diet was 91.4 percent compared with 94.3 percent from the high-fat diet. Values in the USDA food tables (Handbook 8) overestimated the metabolizable energy of these diets by 5 and 8 percent, respectively.

*Energy and Protein Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD  
Carolyn W. Miles (formerly with ARS),  
(202) 245-3117/Paul W. Moe, (301) 344-2059*

**Older people, particularly women, may need more vitamin B6 than currently recommended.** A recent 3-month study of men and women between 61 and 71 years old broadens the age range of data for setting future RDAs for vitamin B6. These are now based on studies of younger adults. The 6 women in the study required 1.9 milligrams of B6 compared to the current RDA of 1.6 mg. And the 6 men needed 1.96 mg. That's equal to the current 2-mg RDA, leaving no safety margin normally built into an RDA. It also appears that B6 requirements for both sexes tend to equalize as people age. The findings help to explain why older people repeatedly test more deficient in the vitamin than younger people. Marginal deficiencies don't produce clinical symptoms and can only be detected through biochemical tests. Since B6 is important for the proper functioning of the nervous system, a persistently low intake could lead to depression, lethargy, confusion or nervousness. But these symptoms also could result from several other causes. Poultry, red meat, fish, fruits, vegetables and grain products all provide good amounts of vitamin B6. The richest sources are fortified cereals, roasted breast of chicken and Cornish hen and braised beef liver.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Judy D. Ribaya-Mercado, (617) 556-3128*

**New findings underscore why fish oil capsules may not be recommended for diabetics.** The capsules significantly altered levels of some hormones and opiates involved in metabolizing glucose and fat in 40 healthy, nondiabetic men. After taking 15 grams of fish oil daily for 10 weeks, the men had lower levels of the hormones glucagon, cortisol—which works against insulin—and somatomedin-C. The levels of beta endorphin—an opiate secreted along with glucagon—were also reduced. On the other hand, blood sugar levels increased as has been reported by other researchers. Taking vitamin E along with fish oil capsules did not reverse the changes in blood glucose, hormones or opiates except for somatomedin-C. Some studies suggest that fish oil may be beneficial in reducing incidence of heart disease by lowering blood triglycerides and other lipids, and increasing tissue sensitivity to insulin. However, in diabetics, its effects on some central hormones involved in glucose metabolism could be detrimental.

*Carbohydrate Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD  
Sam J. Bhathena, (301) 344-2422*

**How does a change in diet affect the rate at which infants and adults synthesize cholesterol?** The answer to that question is now possible with a harmless new test. Since the bulk of cholesterol circulating in people's blood—around 70 percent—is synthesized in the liver, the new test will better define how different foods and other factors affect blood cholesterol levels. Ultimately, it will help researchers determine the ideal cholesterol intake from birth through childhood. U.S. children have higher cholesterol levels than those in other parts of the world, and their levels further increase starting in the late teens. Subjects merely drink some "heavy water," or deuterium oxide, and give several small blood samples. Researchers can calculate changes in the rate of cholesterol synthesis from changes in the deuterium content of cholesterol in red blood cells. The test has proved to be a sensitive measure of cholesterol synthesis in all ages. For example, cholesterol synthesis in five adult volunteers dropped by two-thirds within 1 to 4 days after they began eating five egg yolks daily. Early results with infants show that breast-fed infants synthesize far less cholesterol than formula-fed infants. This was expected because breast milk is very rich in cholesterol whereas infant formula contains none of the sterol.

*Children's Nutrition Research Center, Houston, TX  
William W. Wong/Peter D. Klein, (713) 798-7000*



**Breast-fed babies have a lower heart rate than formula-fed infants** of the same age. They also spend less time in rapid-eye-movement (REM) sleep than their counterparts on formula, new studies show. These observations help explain why breast-fed infants burn fewer calories when they sleep. But they do not account for all the difference in basal metabolic rates between the two groups. The findings corroborate other reports that breast-fed infants differ physiologically from formula-fed infants, but long term significance of these differences is not known.

*Children's Nutrition Research Center, Houston, TX  
Nancy F. Butte, (713) 798-7000*

**African Americans can use an increasingly popular method of estimating body composition** via a person's electrical conductivity. Bioelectrical impedance activity (BIA), which sends a faint current between electrodes placed on the wrists and ankles, gives an estimate of total body water using certain equations. However, the equations were developed using a Caucasian population. So ARS researchers tested BIA on 88 African Americans between the ages of 19 and 50 to estimate total body water. The estimates were slightly lower than those obtained with deuterium oxide—a recognized standard for estimating total body water. But the difference was biologically insignificant. BIA equations, therefore, appear to be appropriate for African Americans.

*Energy and Protein Nutrition Lab, Beltsville Human  
Nutrition Research Center, Beltsville, MD  
Joan M. Conway, (301) 344-2977*

## **Soil, Water and Air**

**No signs of a warming trend from the greenhouse effect were found** in a recent analysis of data from nearly 1,000 weather stations across the country. Actually, average U.S. temperatures decreased by a fraction of a degree during the past 70 years. While most scientists agree the Earth's climate is slowly changing, an ARS scientist says concerns about future catastrophic greenhouse effects, like polar ice caps melting, are unfounded and need to be reevaluated. He studied data from the U.S. Historical Climatological Network comprising 1219 weather stations that have long-term records. The sites were far enough away from large urban "hot spots" so as not to distort the average temperatures for other areas of the country.

*U.S. Water Conservation Lab, Phoenix, AZ  
Sherwood B. Idso, (602) 379-4356*

**After 5 years, herbicides have yet to show up in groundwater below 14 feet**, where they might otherwise migrate into drinking water. The long-term study at Beltsville, Md., compares pesticide movement under standard tillage with "no-till" planting practices under conditions common in the Corn Belt. The herbicides (atrazine, alachlor and cyanazine), the amounts used, the soil type and the rainfall patterns in Beltsville are all similar to those in the Midwest. On no-till fields, seeds are planted without plowing under previous crop residues. Among the findings to date: Regardless of the type of tillage, herbicides are mainly confined to the upper 12 inches of topsoil and none have been found in groundwater below 14 feet. No-till plots have substantially less herbicide residue in the top 4 inches of soil than conventionally tilled fields, but more residue in the next 8 inches. The pesticide levels in groundwater sampled at 5- to 36-foot depths have usually been well within health advisory levels of the Environmental Protection Agency. Where the residues approach or exceed advisory levels upon initial testing, they drop back within 2 or 3 days. This research project will continue another 4 years, and the data will be used to validate computer models to predict chemical movement in each major crop-growing region of the country.

*Pesticide Degradation Lab, Beltsville, MD  
Allan R. Isensee/Ali Sadeghi, (301) 344-3297/2693*

**Sorghum's ability to soak up soil nitrogen like a giant sponge could make it ideal** for cleaning up city waste disposal sites. Its extensive, fibrous root system absorbs nitrogen from the soil, reducing leaching and potential groundwater pollution. ARS researchers evaluated six types of sorghum—tropical, forage, sudangrass, grains, sweet and a sorghum-sudangrass cross—for their ability to remove nitrogen from a municipal sludge disposal site. On average, the sorghums took up about 200 pounds of nitrogen and yielded about 8 tons of dry forage per acre. The forage can be fed safely to livestock on feedlots or dairy farms.

*Wheat, Sorghum and Forage Research, Lincoln, NE*  
Kenneth D. Moore/Jeffrey F. Pederson,  
(402) 472-1561

**A new 60-second field test for soil salinity** is just as accurate as current tests that take up to 12 hours in the lab. Scientists will use the test to more precisely map large saline cropland and direct efforts to reduce salt damage. An estimated 16 million acres—or about one-third of the 50 million acres irrigated nationwide—suffer damage from salts. In the new test, soil and water are mixed to form a paste which is placed in a metal cup. A battery-operated measuring device checks how well a weak electric current flows through the sample. By comparing this reading to a chart they developed, scientists discover the salt content.

*U.S. Salinity Lab, Riverside, CA*  
James D. Rhoades, (714) 369-4814

**Forage for Wyoming livestock and wildlife is growing once again on 11,000 acres of land reclaimed** from mining operations. Using ARS-developed technology, Wyoming officials spent nearly \$57 million over 5 years to reclaim the sterile land that had been abandoned after bentonite mining and before state laws regulated such operations. Key to the successful reclamation: Adding to the land 30 tons per acre of wood chips, bark and sawdust from lumber mills—plus 10 pounds of nitrogen fertilizer for each ton of wood waste. Other states with large areas of similar derelict land could use the technology. Scientists have shown that cattle grazing similar reclaimed lands gain weight as well as other animals grazing on native range in the Northern Plains.

*High Plains Grasslands Research Station,  
Cheyenne, WY*  
Gerald E. Schuman, (307) 772-2433

**Underground tubing that provides both drainage and irrigation can boost soybean yields** for Midwestern farmers. The dual-purpose system provides a constant water table in the soil during the growing season. In a 4-year study in Ohio, soybeans yielded about 19 percent more where the water table was maintained at 16 inches below the soil surface than with the water table at 28 inches. During the 2 driest years, yields of soybeans with the 16-inch water table averaged 80 bushels per acre, 24 bushels more than non-irrigated beans. Costs of installing dual-purpose tubing may be as much as 50 percent higher than for drainage tubing alone because of closer spacing and water-depth control structures needed for irrigation.

*Corn and Soybean Research, Wooster, OH*  
Richard L. Cooper, (216) 263-3875  
*Soil Drainage Research, Columbus, OH*  
Norman R. Fausey, (614) 292-9806

**It may not pay for grain sorghum farmers in the Southern High Plains to irrigate before planting.** A 4-year study has shown that West Texas sorghum farmers pay \$26 an acre to pump enough water from the Ogallala Aquifer to ensure a moist seedbed. But the average 10 percent gain in crop yield amounted to only \$21.85 an acre. Each pre-plant irrigation used a third of the entire season's water. And three-quarters of the water was lost to seepage and evaporation. The disadvantage of skipping the pre-plant irrigation is that farmers have to wait for rain before planting. But less rain is needed to moisten a flat seedbed than the raised beds formed when surface soil is pushed aside to form irrigation furrows. Also, rain from a brief thunderstorm tends to run off raised beds into the furrows, out of reach of seeds.

*Water Management Research, Conservation and  
Production Research Lab, Bushland, TX*  
Ron R. Allen/Jack T. Musick, (806) 378-5728



Scattering straw so it forms mini-dams in crop furrows can save water and soil—and increase yields—when farmers irrigate. One to three pounds of straw scattered along 100 feet of furrow slows the water flow and cuts runoff down the furrow by nearly half, according to a study in southern Idaho. That helps protect erodible silty loam soils, which are fine and powdery when dry. The straw mini-dams also make irrigation water rise higher in the trench. As a result, it soaks through the furrow sides and moves directly towards plant roots. In tests, extra water for the roots boosted yields of dry beans by as much as 62 percent. Yield results were similar for irrigated sugarbeets, corn and potatoes.

*Water Management Research, Kimberly, ID*  
*Melvin J. Brown, (208) 423-5582*

Bait minnows may serve as environmental sentinels for East Coast estuaries. ARS scientists are studying living mummichogs with magnetic resonance imaging to diagnose what they suspect is a water pollution-caused cancer at an early stage, much as similar machines are used in hospitals. The image shows pre-cancerous tissue damage. The mummichog is the first candidate in ARS' search for plants, animals or tissue that can be used as biosensors. Biosensors are living indicators of changes in water quality. ARS is interested in biosensors to be sure fertilizers and pesticides are used safely. The mummichog, whose scientific name is *Fundulus heteroclitus*, can be netted from a brackish bay, tested with magnetic resonance imaging and returned unharmed. It came up for consideration as a biosensor when autopsies by Virginia Institute of Marine Science colleagues revealed a prevalence of liver tumors in mummichogs in an industrial discharge area of Virginia's Elizabeth River. Also, the fish are abundant along the entire East Coast and do not migrate. Therefore, local populations should reflect the health of their immediate environments.

*Environmental Chemistry Lab, Beltsville, MD*  
*George Gassner III, (301) 344-1030*  
*Virginia Institute of Marine Sciences,*  
*Gloucester Point, VA*  
*Wolfgang Vogelbein, (804) 642-7261*

Corn yields can fall off as much as 16 bushels an acre where wheeled farm machinery packs the soil, according to a 3-year study on an Iowa farm. Yearly records were kept on three fleets of tire and track-mounted farm machinery used for all field operations—preparing seedbed, planting, harvesting and moldboard plowing. Corn fields farmed with tire-equipped machinery averaged only 86 bushels an acre; those where rubber-tracked vehicles were used averaged 98 bushels; and fields in which longer, wider experimental tracks for lower ground pressure were used averaged 102 bushels. For each pass through the fields, tractors with tires exerted 18 pounds of ground pressure per square inch of soil; rubber tracks, 4 pounds; and low ground pressure tracks, 2.5 pounds. Compaction not only reduced yields but also increased the soil's bulk density, making it less able to hold oxygen, nitrogen and moisture. ARS scientists worked with researchers from Iowa State University and Caterpillar Inc., Peoria, Ill.

*Soil Tilth Research, National Soil Tilth Lab,*  
*Ames, IA*  
*Donald C. Erbach, (515) 294-5725*

## **Animal Production and Protection**

**Brucellosis eradication efforts should get a boost** from a new diagnostic test. Each year, cattle brucellosis costs U.S. cattle producers an estimated \$12 million. ARS researchers are developing a diagnostic test using polymerase chain reaction (PCR), a technique that makes many copies of targeted genetic material found only in *Brucella abortus* bacterium. Used on 30 randomly selected field isolates, the PCR method correctly identified *B. abortus* in all 30 samples. The PCR test can identify the organism in 1 day and could replace current methods that take several weeks. It can also make diagnostic work safer for humans because it doesn't require the use of live bacterial cells, which can infect humans.

*Brucellosis Research,  
National Animal Disease Center, Ames, IA  
Betsy J. Bricker, (515) 239-8310*

**Just like humans, different beef cattle react to stress in different ways**—and with cattle, genetics also counts. When an animal is stressed, a chemical “chain reaction” originating in the animal's brain causes its adrenal gland to produce hormones called glucocorticoids. A chronic overabundance of glucocorticoids can interfere with the animal's built-in defenses against disease. In tests, researchers tracked the levels of the most important glucocorticoid, called cortisol, in the blood of calves being weaned, transported and otherwise stressed. On a day-to-day basis, the calves with some *Bos indicus* breeding, typified by the Brahman breed, had as much as 50 percent more cortisol in their blood. But when all of the calves were injected with a compound to stimulate cortisol release in their bodies, those calves with *Bos taurus* breeding, typified by the British breeds, produced more cortisol. Researchers say this difference could affect disease resistance capabilities among the various breeds.

*Forage and Livestock Research, El Reno, OK  
Michael T. Zavy, (405) 262-5291*

**A single gene from an Australian sheep breed may lead to a “baby boom” among other breeds.** Imported by ARS in 1983, the Booroola Merino breed is known for its prolificacy. Early studies have shown that one copy of the Booroola Merino gene in a ewe of another breed can increase her ovulation by 1.5 eggs above the norm. A crossbred ewe with two of the genes will likely have a 3-

egg increase. Mature Booroola Merino ewes average 2.7 lambs each, compared with 1.5 to 1.9 lambs per ewe for other breeds. Scientists believe several generations of crossbreeding and selection for the Booroola Merino gene will make it possible to increase the production rate in any sheep population.

*Roman L. Hruska U.S. Meat Animal Research Center,  
Clay Center, NE  
Lawrence D. Young, (402) 762-4169*

**Going to market may take a greater toll on hogs than previously thought.** Typically, it is assumed that hogs headed for market will lose 3 percent of their weight because of travel stresses and deprivation of food and water prior to shipping. But ARS researchers found the loss may be greater, depending on how long the hogs are off feed and water and how far they're transported. Going without feed and water for up to 48 hours caused most of the live weight losses—as much as 7 percent, and more than 50 percent of the carcass weight losses. Transport and related activities caused additional weight losses of up to 3 percent. Scientists say the study provides useful information to all parties involved in the shipment of slaughter-weight hogs.

*Biological Engineering Research, Clay Center, NE  
G. LeRoy Hahn/John A. Nienaber, (402) 762-4272/4274  
Animal Physiology Research, Columbia, MO  
Herman F. Mayes (retired)/B. Ann Becker/  
Maynard E. Anderson, (314) 882-6261/1135*

**“Putting a little flesh on those bones” takes on special meaning when breeding beef cattle.** It's known that mature cows must be in good physical condition to become pregnant. Researchers think body fat also may play a part in how quickly heifers of different breeds reach puberty and can be bred for the first time. An example: The Brahman, widely used in subtropical climes such as Florida, may not reach puberty until an average of 602 days of age, whereas Angus reach that stage in 503 days. Researchers have begun a 3-year study comparing Hereford and Senepol heifers, as well as crossbred Hereford-Senepols, on different diets to pinpoint the animals' body composition at the time they conceive. Other aspects of this study on puberty and heifers also include the Angus and Brahman breeds. The researchers' findings could help cattle producers fine-tune heifers' diets to speed up puberty in typically slower breeds for a quicker return on their herd maintenance dollars.

*Beef Cattle Research, Brooksville, FL  
Andrew C. Hammond, (904) 796-3385*



A tiny biting midge that spreads bluetongue in sheep and cattle could help scientists isolate why some insects are a worse threat to pass along diseases to plants, animals and humans. So far, scientists have bred insect populations that vary from 5 to 90 percent in their ability to spread bluetongue viruses. Next step is to use state-of-the-art techniques, including DNA restriction fragment length polymorphisms, to map the genes of the *Culicoides variipennis* midge and find what makes insects like this one an excellent disease carrier. Such genetic mapping could help scientists find other techniques to curb the spread of other livestock diseases and human diseases such as yellow fever, encephalitis and dengue, as well as plant diseases caused by insect-carried viruses.

*Arthropod-borne Animal Diseases Lab, Laramie, WY*  
Walter Tabachnick, (307) 721-0305

Reducing damage typically associated with parasite infections in cattle may be more a matter of keeping the parasites "quiet" than killing them altogether. Once internal parasites have settled into the animal's gastric glands, they cause little significant damage. However, they do excrete harmless chemical substances, including an attractant that lures infection-fighting white blood cells called eosinophils. But the arrival of the eosinophils is hardly good news. That's because they bring along toxic enzymes designed to destroy the invading parasites. Unfortunately, these enzymes also destroy the gastric glands where the parasites are nestled. The result: Impaired digestion for the animal. Researchers are now studying the substances secreted by some parasites in hopes of eventually using them as the basis for a vaccine. This vaccine would be designed to stimulate the animal's immune system to produce antibodies that would quickly neutralize a parasite's secretions. The eosinophils would never get the signal to mobilize against the parasite and therefore would not damage the gastric glands.

*Animal Parasite Research, Auburn, AL*  
Phillip H. Klesius, (205) 887-3741

Cheap, easy-to-make covers for livestock water tanks are cutting water losses at more than 100 locations in western states, according to a recent survey. The survey revealed these covers have lasted 10 to 15 years. In the 1970's ARS developed the covers, which prevent up to 4 feet or more of water a year from evaporating from open tanks. Ranchers make the covers from rolls of foam rubber 1/4-inch thick and 4-feet wide. Light enough to float on water, the covers are heavy enough to resist most winds on the open range.

*U.S. Water Conservation Lab, Phoenix, AZ*  
Allen R. Dedrick, (602) 379-4356

Long, tedious hours of lab work to diagnose bovine viral diarrhea (BVD) could become a thing of the past. Newly developed DNA probes detect the virus in 1 to 2 days. Studies show the technique can detect 96 percent of one of the two major biotypes (strains) of BVD and 43 percent of the second biotype. The DNA probes were designed to react with genes common to many BVD strains. In lab tests, the DNA probes will bind to the BVD virus within the animal's cells if the animal is infected. Once the tests are improved to detect a higher percentage of a biotype, these new tests will be used to study the prevalence and spread of BVD in large populations of cattle and to develop effective control measures.

*Animal Health Systems Research, Clay Center, NE*  
Jimmy Kwang/Travis Littledike, (402) 762-4372/4177

Extra fiber in a goat's diet can mean extra milkfat in that goat's milk. Researchers fed 40 Alpine dairy goats diets ranging in dietary fiber (acid detergent fiber, or ADF) content from 14 to 26 percent. The goats' milk production was not significantly changed by the differences in dietary fiber. But milk from the goats receiving the 26 percent ADF diet contained 5.8 percent milkfat, compared with 5.3 percent milkfat in the milk from goats on the 14 percent ADF diet. Goats' milk typically contains 4.5 to 5 percent milkfat. Dairy goat producers striving for higher milkfat production might do well to boost their herds' fiber intake, the researchers say.

*Forage and Livestock Research, El Reno, OK*  
Samuel W. Coleman, (405) 262-5291

**Skimping on feed can backfire for goat producers** trying to save money. In field tests, Angora goats lost weight on a low-quality diet. Other breeds gained less than they did on a high-quality diet. But when fed a high-quality forage diet for 10 weeks, young Alpine and Nubian goats gained an average of 45 grams a day, while the Angoras gained an average 60 grams a day—10 grams of that in hair. When diet quality dropped, the Alpines still managed to gain 24 grams a day and the Nubians gained an average 19 grams a day, but the Angoras lost an average 8 grams of weight per day. Scientists say Angoras are unique because they are genetically programmed to produce mohair, even at the expense of body maintenance, so a good-quality diet is essential for this breed.

*Forage and Livestock Research, El Reno, OK  
Steven P. Hart, (405) 262-5291*

**A "temper tester meter" hung near a honeybee hive, records how many times bees attempt to sting it.** That's an indication of their demeanor, especially Africanized bees that are crossing into Texas from Mexico. When provoked, Africanized bees sting often and in a swarm, while the European bees found in this country usually inflict only one or a few stings. Once hostile hives have been located, they can be destroyed or the mean queen can be replaced with a gentle one who will produce friendlier offspring. ARS scientists continue to refine their patented electronic stingometer in Costa Rica, already invaded by Africanized bees, so it can be used as a way to protect people in this country. (PATENT)

*Carl Hayden Bee Center, Tucson, AZ  
Hayward G. Spangler, (602) 670-6380*

## **Crop Production and Protection**

**A new test to safeguard citrus plantings** against one of the most serious and costly virus problems is now being used in Florida. Both Florida and California citrus are highly susceptible to citrus tristeza virus (CTV), which is spread by aphids. CTV incidence is expected to increase in both states. Many diverse strains of CTV exist. Some are extremely damaging, others are very mild. Some mild strains may even be beneficial, since they can protect citrus trees from infection by severe strains. Accurately identifying the severity of a CTV strain thus becomes very important, but the only previous tests available were expensive and time consuming. The new ARS test rapidly discriminates mild from severe sources of CTV in Florida and scientists hope it will work equally well in California. Based on the use of highly specific monoclonal antibodies, the patented test is inexpensive, very accurate and simple to use. (PATENT)

*Horticultural Research Lab, Orlando, FL  
Stephen M. Garnsey, (407) 897-7300*

**Growing safflower instead of wheat can earn up to twice as much per acre** for some Northern Great Plains farmers. Scientists who studied safflower's soil, climate and nutrient needs say its production costs are comparable to those for wheat and uses the same farm equipment. Currently, farmers on the Northern Great Plains grow about 100,000 acres of safflower annually without irrigation. An additional 2 to 3 million acres are suited to the crop, say ARS scientists. By rotating safflower and wheat, farmers could avoid some of the risk of diseases and insects that can build up in fields planted to the same crop every year.

*Northern Great Plains Station, Sidney, MT  
Kris Aase, (406) 482-2020*



**X-rays are helping researchers overpower the Hessian fly**, a pest that has plagued wheat fields for nearly 2 centuries. Breeding resistant genes into wheat varieties has protected the crop for the past 30 years. But this is becoming less effective as the Hessian fly adapts and is able to overcome the genes. In the quest for new genetic resistance, researchers turned to resistant rye—and X-rays. Irradiating pollen of a rye/wheat hybrid transferred a gene for Hessian fly resistance from a rye chromosome to a wheat chromosome. Subsequent use of this pollen, and then breeding several generations to wheat yielded three pure wheat lines with Hessian fly resistance. Seed from the lines should be available to private and commercial breeders within the next year.

*Plant Science and Entomology Research,  
Manhattan, KS  
J.H. Hatchett, (913) 532-6154*

**Plants need the right amount of zinc in the soil** around roots to thrive, scientists say. Without sufficient zinc, root cell membranes are weakened and can leak crucial contents such as phosphorus and chloride. These weakened root cells leave plants less capable of withstanding conditions such as acidic soils or drought. ARS scientists grew plants in nutrient solutions containing different levels of zinc and have pinpointed the right zinc concentration for top plant performance. Their next task: Finding ways to correct zinc levels in soil. Such corrections are difficult because zinc added to soil simply sticks to the soil particles and won't move freely to reach plant roots in required levels.

*U.S. Plant, Soil and Nutrition Research,  
Ithaca, NY  
Ross M. Welch, (607) 255-5434*

**Seed yield of pearl millet increased by up to 30 percent** when scientists moved beehives close to the fields, so the bees could help pollinate the crop. Higher yields could make seed cheaper and help lesser developed countries like Sudan and India that rely on millet as a substantial source of protein. Along with grinding seed into flour, people overseas soak and boil millet seed as we do dry beans. Scientists are anxious to learn how well honey bees can boost seed production of other grasses.

*Carl Hayden Bee Center, Tucson, AZ  
Amed Namood/Justin Schmidt, (602) 670-6380*

**Consumers sometimes pay higher prices for onions** because honeybees don't like the nectar in onion plants grown in California and Arizona during the winter. Without the bees pitching in to pollinate, only onion flowers that receive airborne pollen will produce seed. This less-than-ideal pollination severely cuts seed yields in the two states—sometimes up to 80 percent. Such low seed yield pushes up onion prices in supermarkets. But, scientists have found enough genetic variability among onions to enable plant breeders to develop sweeter nectar in onions to attract bees. Onion seed could then be produced year-round in the two states. Bees—for unknown reasons—don't find onion nectar objectionable in plants growing during the summer in the Pacific Northwest.

*Carl Hayden Bee Center, Tucson, AZ  
James R. Hagler, (602) 670-6380*

**A new cotton variety with exotic genes from wild varieties could reduce pesticide use** and increase profits for the nation's farmers. A genetic trait transferred by ARS scientists from the wild Hawaiian cotton species *Gossypium tomentosum* gives new resistance to three of cotton's four major enemies—the bollworm-budworm, plant bug and pink bollworm. Insects aren't attracted to the wild Hawaiian species because it doesn't produce nectar, which many insects feed on at some stage of their life cycle. Also, the new variety has fiber-strength traits from three different wild cotton species native to South America, Asia and Central America. Those species are *G. arboreum*, *G. thurberi* and *G. barbadense*. Genes from all four wild cottons were transferred into the popular cotton variety—Deltapine 90—to produce the new variety called "MD 51 ne." The new variety offers the Mid-South for the first time a variety with the fiber strength of California's Acala varieties and yields competitive with current commercial varieties. ARS offered a one-time release of MD 51 ne to cotton breeders and seed producers. The initials "MD" stand for Mississippi Delta.

*Cotton Physiology and Genetics Research, Stoneville, MS  
William R. Meredith, Jr., (601) 686-5241*

Potatoes carrying genes borrowed from chicken eggs, moths or bacteria might better resist rots, bruise-related blackening, or herbicides. Eight different genes are being tested outdoors—most for the first time—in genetically engineered potatoes growing at test sites in Maine, Minnesota, North Dakota and Idaho. ARS researchers and their university colleagues inserted genes in five potato varieties: Atlantic, Katahdin, Russet Burbank (America's most widely planted potato) Lemhi Russet, and an experimental variety owned by Frito-Lay. A bacteria-fighting gene found in chickens is among those being tested in the potatoes. In chickens, this gene protects an embryo from infection until the chick develops its own immune system. The field tests could show whether the gene can help potatoes fend off destructive bacterial rots such as soft rot and ring rot. Antibacterial genes from the giant silk moth might similarly protect the high-tech potatoes; a gene from the greater wax moth might prevent ugly black spots from forming under the skin of tubers bruised at harvest.

Process Biotechnology Research,  
Western Regional Research Center, Albany, CA  
William R. Belknap, (415) 559-6072  
Small Grains and Potato Germplasm Research,  
Aberdeen, ID  
Dennis L. Corsini/Joseph J. Pavek, (208) 397-4181

Fragrances that mimic the aroma of night-blooming flowers might lure moths from corn and cotton fields before they mate and breed a new generation of destructive caterpillars. The attraction should be fatal when the fragrance is combined with an insecticide-laced bait. *Helicoverpa zea* moths are vulnerable to this trickery: After changing from immature pupa to adult moths, they first seek tasty nectar, not a mate. ARS researchers have shown that the moths forage for nectar from night-blooming weeds such as *Gaura drummondii*, *G. longiflora*, and *G. suffulta*. A dozen key fragrance-imparting chemicals have been identified from the blossoms. Further tests will reveal the blend that yields the most potent lure. Floral lures mixed with a poisoned bait would give tomorrow's growers and backyard gardeners a new, environmentally friendly tool for fighting *H. zea* moths—known by three aliases: Corn earworm, tomato fruitworm and cotton bollworm. Each year, the caterpillars cost U.S. farmers about \$1.5 billion in crop damage and the expense of buying and applying insecticides.

Crop Insect Pests Management Research,  
College Station, TX  
Peter D. Lingren, (409) 260-9351

Subtropical Cotton Insects Research, Weslaco, TX  
Jimmy R. Raulston, (512) 968-6739  
Plant Protection Research,  
Western Regional Research Center, Albany, CA  
Roy Teranishi, (415) 559-5659

Two pesky nematodes—tiny worms that attack roots—face a tougher enemy in lab-strengthened strains of a beneficial fungus. Scientists suspect that the *Verticillium lecanii* fungus kills soybean cyst and root knot nematodes by parasitizing eggs and by emitting a toxin. Soybean cyst nematodes primarily attack soybeans; the root knot species also assaults tomato, strawberry, squash, bean and other crops. In a small outdoor test in soybean plots this summer, researchers will see how well one *V. lecanii* strain altered by an ARS scientist can control the soybean cyst nematode. The field tests are being run under a cooperative agreement between ARS and a Maryland firm, Crop Genetics International. If the fungi pass rigorous field tests in this and following years, farmers could have new natural controls for the pests. Plus, they'd have an option of continuing to use a registered fungicide, benomyl, against disease-causing fungi without harming the beneficial *V. lecanii*. In the lab, the ARS scientist induced potentially useful genetic mutations in the fungus. She also screened thousands of fungus colonies to identify strains highly resistant to benomyl. In greenhouse tests benomyl-resistant fungi killed as many as 98 percent of soybean cyst nematodes, compared to no better than 52 percent for unaltered fungus at the same application rate. (PATENT)

Nematology Lab, Beltsville, MD  
Susan Meyer, (301) 344-5091

Cherry tomatoes now being nurtured in test tubes could lead to high-tech indoor farming in the 21st Century. Lab tomatoes raised by an ARS researcher have tiny "leaves" that aren't supposed to ripen like tomato fruit, but did. Unexpectedly, the calyx—the star-shaped, leaflike cluster at the top of the tomato where it joins the stem—turned red and juicy. Scientists now are working to uncover the genetic mechanism that triggered the unusual ripening. That might speed progress towards indoor farming in which growers could tend and harvest huge vats of billions of fruit and vegetable cells, such as tomato cells for paste, catsup, soup or salsa. This high-tech approach to



food production would require less land, fertilizer and pesticide than traditional farming. But before fruit cells can be cultured for use in foods, scientists must find the ripening trigger and learn how to control it.

*Process Chemistry and Engineering Research,  
Western Regional Research Center, Albany, CA  
Betty K. Ishida, (415) 559-5726*

Two new tomato breeding lines possessing resistance to the fungal disease called early blight have been developed by ARS scientists. Early blight is commonly controlled by weekly fungicide spraying but still costs tomato growers about \$4 million in damage each year. Field studies of crosses between the two new lines and a susceptible variety indicate that resistance can be inherited by hybrid offspring. Plant breeders can select from the new lines to find hybrids with built-in resistance.

*Vegetable Lab, Beltsville, MD  
Stephen L. Sinden, (301) 344-3380*

Sugarcane infected with the fungus that causes the red rot disease also contained a surprise ingredient. Researchers discovered a compound that plants produce to block growth of microorganisms. Called piceatannol, the compound is the first instance in the grass family of a class of chemicals called stilbenes. Some stilbenes impede fungi germination and growth. Scientists hope further studies of fungal-inhibiting compounds can help them better understand how to help plants fight fungal diseases.

*Bioactive Constituents Research, National Center for  
Agricultural Utilization Research, Peoria, IL  
Anita M. Brinker, (309) 685-4011, Ext. 349*

Bronze birch borers have long ravaged the tall, white-barked birch trees that are so popular for landscaping. But hybrid birches are being developed that nearly eliminate what lures the borers: A type of alcohol. ARS scientists found that birch trees susceptible to the pest produce, under stress, a particular attractant, a phenolic alcohol called rhododendrol. The new hybrids are crosses between a white-barked birch and a river birch which is not susceptible to the borer. Their bark produces only a trace of rhododendrol. The hybrids are being field tested to verify their potential resistance.

*U.S. National Arboretum, Washington, DC  
Frank S. Santamour, Jr., (202) 475-4824*

## **Biological Control**

To male codling moths seeking a sexual rendezvous, females seem everywhere—but are rarely found. That's what happens when a phony sex scent wafted throughout the apple orchard, frustrating the male's search. No mating means no moth eggs and no worms in apples. Such mating disruption reduces the reliance on pesticides, employing instead thin plastic dispensers twisted onto tree branches. The 7-inch dispensers slowly release a fake version of the female moth's sex scent. ARS scientists did research to fine-tune the ratio and amounts of the sex-scent chemicals effective in orchards. In 1-acre test orchards, researchers found 85 to 90 percent control of codling moths. A 90 percent control level translates to worm damage in fewer than 1 percent of the apples—very close to what commercial growers achieve with pesticides. Recent approval of the dispenser by the Environmental Protection Agency opens the way to large-scale tests in commercial orchards.

*Fruit and Vegetable Insect Research, Yakima, WA  
James L. Krysan, (509) 575-5945*

A new dispenser for sex scent of female gypsy moths is being field-tested in 1,000 detection traps this season. Federal and state officials use the scent, called disparlure, in about 300,000 monitoring traps each year to determine when and where to spray for caterpillars. But the current dispenser, a plastic laminate strip, is patented and available from just one company. ARS scientists evaluated other dispensers over the years, but none worked as well. So they joined forces with USDA's Animal and Plant Health Inspection Service to develop a new pheromone-impregnated dispenser—a polyvinylchloride coated twine. So far, it attracts male moths as well as the laminate in lab and field tests. (PATENT)

*Insect Chemical Ecology Lab, Beltsville, MD  
Barbara A. Leonhardt, (301) 344-4394*

**An ingredient in laundry bleach could mean big trouble for gypsy moths.** In lab tests, a fluorescent whitener—which gives bleach its punch—increased the killing power of a natural virus called Abby by at least 10-fold. Originally added to the biocontrol virus to protect it from harmful ultraviolet rays, the whitener unexpectedly increased Abby's potency. Scientists think the whitener increases how fast the virus multiplies inside the insect or helps the virus enter the insect's system faster—or both. The whitener works on other viruses and insects, but scientists are concentrating efforts on the devastating gypsy moth. Gypsy moth caterpillars defoliate shade, park and forest trees on 13 million acres in the Northeast and other areas. Commercial companies are interested in licensing the use of whiteners to help viruses attack the gypsy moth and other insects. (PATENT)

*Insect Biocontrol Lab, Beltsville, MD  
Martin Shapiro, (301) 344-4327*

**Officials wanting to disrupt gypsy moth mating may have found a cheaper way to do it.** In mating disruption—so far used only experimentally—officials distribute chopped up plastic impregnated with the female sex scent. This confuses males so they can't find females emitting the real scent. AgriSense in Fresno, Calif., sent ARS researchers several kinds of microbeads containing the scent. Scientists picked the best on the basis of lab tests. AgriSense, ARS and two other USDA agencies (Forest Service and Animal and Plant Health Inspection Service) will compare the beads and chips in a 500-acre study. Thousands of the beads can be released via normal aerial spraying, which is cheaper than the special airplane equipment required to dispense chips.

*Insect Chemical Ecology Lab, Beltsville, MD  
Barbara A. Leonhardt, (301) 344-4394*

**A wasp called *Coccygomimus disparis*, which attacks inactive gypsy moth pupae,** shows promise as a new gypsy moth biocontrol. ARS scientists originally imported the wasp from Japan and India and then released it on the east coast in the early 1970s. They didn't find it for years. In 1989, they located it in one spot where 1/10th of a percent of caterpillars had the parasites in them. By 1990, the wasp appeared at eleven different sites in the Delmarva (Delaware-Maryland-Virginia) peninsula along the Atlantic coast. Scientists found 97 wasps and the level of parasitism

had jumped to 4 percent. Anything over 10 percent parasitism is considered highly promising, so the scientists will monitor the peninsula for another few years to see if wasp populations continue to build.

*Beneficial Insects Introduction Research, Newark, DE  
Paul W. Schaefer, (302) 731-7330*

**When the fungus *Aspergillus parasiticus* produces a natural toxin** known as aflatoxin, it can mean heavy financial losses to peanut growers. But not all *A. parasiticus* strains make aflatoxin. ARS scientists are seeking a patent on the use of selected non-toxin-producing strains to control native aflatoxin-producing strains in peanut fields. The non-toxin-producing strains would be added to the soil to compete against and replace toxin-producing strains found naturally in the soil. Peanuts subjected to late-season drought stress would be invaded predominantly by the biocompetitive, aflatoxin-free fungus. A 3-year preliminary study that began in 1987 showed dramatic reductions in aflatoxin contamination when beneficial fungi were applied to soil. In 1990, aflatoxin contamination resulted in an estimated \$100 million loss to the nation's peanut growers. (PATENT)

*National Peanut Research Lab, Dawson, GA  
Richard J. Cole/Joe W. Dorner/Paul D. Blankenship,  
(912) 995-4441*

**A tennis ball canister sparked an idea for a new trap that spells death for beetles** hiding in stored products. It's designed to catch most of these pests that can infest packaged and bulk foods, such as flour, cereals, cornmeal, peanuts and grains stored in warehouses. An ARS scientist experimented with part of the concave bottom end of the canister and combined that with a portion of the top. Notches in the canister provide entrance ways for the pests and a plastic lid contains a sex attractant to lure beetles into the trap. An inescapable pit was devised inside the canister, and the smooth surface was roughened so beetles will crawl towards a corn-based bait. When the pests try to reach the bait, they fall onto a sticky substance and are unable to escape. (PATENT)

*Stored-Products Insects Research and Development Lab,  
Savannah, GA,  
Michael A. Mullen, (912) 233-7981*



## Scientific Information Systems

**Mosquitoes may multiply rapidly, but computers can still keep track of them.** ARS has two new computer models that predict mosquito numbers based on weather conditions and various strategies used to control them. PCSIM (*Psophora columbiae* Simulation Model) simulates dynamics of the riceland mosquito that attacks cattle. CIMSIM (Container Inhabiting Mosquito Simulation Model) zeros in on mosquitoes such as the common biter, *Aedes aegypti*, that breeds in abandoned tires, tree holes and other water catches. ARS scientists have programmed data into both models, such as how weather variables affect mosquito reproduction and survival and how well different controls kill the pests. Computer simulations can be used to develop integrated management strategies for mosquito abatement programs. And, in a new use, scientists have data on *Aedes aegypti* that transmits dengue fever to humans, and will integrate it into CIMSIM in the near future to help in controlling the disease.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL*

*Dana A. Focks, (904) 374-5976*

**A computer model called MALSIM (Malaria Simulation Model) predicts how many cases of malaria military officials can expect,** given certain weather patterns and control measures. This debilitating and potentially deadly disease is a major concern for military troops stationed abroad. The new program has information about the life cycle of anotheline mosquitoes, including how temperature, moisture and other climatic factors affect their survival. MALSIM also "knows" that a mosquito must incubate malaria 12 to 14 days after biting an infected person before it can transmit the disease to someone else. MALSIM predicts the benefits of different control programs, including aerial spraying or troops' use of personal protection. Though the model hasn't been validated fully in a field situation, the military already is using it as a training tool. Computer simulations convince military leaders to provide protection for troops such as the mosquito killer permethrin for use on clothes and the repellent DEET on skin.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL*

*Daniel G. Haile, (904) 374-5928*

**Counting how many chemical crystals land on a leaf's surface might show which methods of applying a pesticide are the safest for the environment—as well as best for controlling weeds, insects or crop diseases.** More pesticide crystals on leaves means fewer "misses" that could wind up in air, soil or water. Counts of the crystals, applied as a dry smoke or liquid spray, would help the Environmental Protection Agency and others study impacts of pesticides and develop safer, more effective application techniques. But until a recent advance by ARS, there was no way to directly and accurately count how many crystals—no bigger than particles of smoke—land on leaf surfaces. A team of ARS plant disease scientists and agricultural engineers, as well as researchers from the Ohio Agricultural Research and Development Center, is doing this with a high-tech method called Computer Controlled Electron Beam Analysis. CCEBA combines scanning electron microscopy, energy-dispersive X-ray analysis and particle-recognition and characterization software. Tests with a "smoke bomb" fungicide applied to dozens of rhododendron leaves in a greenhouse show that CCEBA could identify and count microscopic fungicide crystals on leaf samples and non-target samples as well. Researchers say CCEBA also could be a reliable way to directly trace whether pesticides drift from a targeted spray area.

*Application Technology Research, Wooster, OH*

*Charles R. Krause, (216) 263-3672*





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# Quarterly Report

## of Selected Research Projects

United States  
Department of  
Agriculture



Agricultural  
Research  
Service

July 1 to September 30, 1991

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### Biological Control

A friendly European weevil that attacks a notorious weed has successfully established small, new colonies in California, Oregon and Washington thistle patches. If these *Eustenopus villosus* weevils flourish at their West Coast outposts, the quarter-inch-long insects could spread and may eventually help control yellow starthistle. This nasty weed poisons horses and jabs hikers with its needle-like spines. The weevils, brown with grey stripes, have soft, short hairs on their backs. They use their long, narrow "snout"—to feed on flower-heads, destroying plant tissue that would otherwise develop into seeds. Starthistle's seeds are the plant's only way of reproducing and spreading. ARS researchers in Europe helped test the weevil to make sure it attacks only starthistle, then last year shipped the insects to a California laboratory for the first-ever outdoor release in the U.S. More weevils, also col-

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 344-2786.

lected in Europe, were released in California, Oregon, Washington, and Idaho this year.

*Plant Protection Research Unit, Western Regional Research Center, Albany, CA*

*Charles E. Turner, (510) 559-5975*

*Plant Germplasm Introduction and Testing Research, Pullman, WA*

*Stephen L. Clement, (509) 335-1502*

Two beetles from Asia may become the first major natural controls for scale pests of ornamental trees and bushes. Euonymus scale insects—one of the most insidious pests of U.S. ornamentals—affix themselves to plants with their needle-like mouthparts. Then they literally milk the plant dry of sap. Pesticides only work for a very short time because they can't penetrate the scale's shell-like armour. The scale also infects 30 other types of plants including pachysandra, hibiscus and camellia. ARS entomologists found the two beneficial beetles at the ARS Asian Parasite Lab in Seoul, South Korea, and sent one or both of the beetles to more than 40 cooperators in about 20 states. Eight years of field studies showed the beetles quickly became established and all but eliminated the scale from many test plots. The two beneficial beetles, *Chilocorus kuwanae* and *Cybocephalus nipponicus*, control scale pests by laying their eggs under the body of the scale. When beetle larvae hatch, they feed voraciously for several weeks on the scale pest and their offspring. Based on the success of this research, USDA's Animal and Plant Health Inspection Service has funded a national project for biological control of euonymus scale that will also include several species of tiny wasps that also attack the scale in Asia. ARS, several universities, and private industry will cooperate in the project.

*Insect Biocontrol Lab, Beltsville, MD*

*John J. Drea, (301) 344-1791*

*APHIS Biological Control Lab, Niles, MI*

*Mike Bryan, (616) 683-3563*

A parasite native to Thailand called *Edhazardia aedis* could be a new biological control for mosquitoes like *Aedes aegypti* that breed in standing water such as in old tires. The tiny parasite attacks mosquitoes with two kinds of infective spores: one type

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floats in still water where mosquitoes live and the second is produced in infected mosquito females and passed on to her offspring. Transmission from females to offspring makes this parasite a good candidate for biocontrol, because infected females looking for a spot to lay eggs would fly to a new tree hole and transmit the disease to a new population. In lab tests, the parasite infects and kills 100 percent of larvae in a container—depending on the dosage of spores. But researchers don't expect control quite that good in the field, generation after generation. Small scale field tests may begin as soon as approval from the Environmental Protection Agency is received.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL*

*Albert H. Undeen, (904) 374-5966*

**Cow's breath kills mosquitoes**—but not because the insects are repulsed by the odor. On the contrary, an element in ruminant breath called octenol successfully attracted mosquitoes into standard insect traps—and could cut use of chemical insecticides. Octenol mixed with carbon dioxide—now used experimentally by a mosquito control district to monitor the pests—attracted 3 to 10 times more mosquitoes than either compound alone in field cage tests. Scientists think octenol attracts mosquitoes from far away, while carbon dioxide attracts those that are closer. The mix could lure mosquitoes into new traps—now being developed by ARS—that officials could remove or discard. But first scientists must determine how much octenol should be released for ideal results, improve the standard trap so it can be produced more cheaply and prove the method in large-scale field tests. Studies focused on *Aedes taeniorhynchus*, a wetland mosquito. Since wetlands are very sensitive to chemical pesticides, a way to trap and remove mosquitoes would be an alternative to spraying with pesticides. Octenol also attracts 4 other mosquito species of 69 tested, including three implicated in transmitting encephalitis viruses.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL*

*Daniel L. Kline, (904) 374-5933*

**An immature moth, found by chance on an Italian cliff, could help send a pesky U.S. weed over the edge.** Leafy spurge infests 5 million acres of rangeland in 37 states. During a mountain-climbing holiday, an ARS entomologist spotted a relative of the weed on a cliff

ledge. Its stems, he noticed, were marred by attacks from larvae of what proved to be *Nephotrix divisella* moths. In preliminary lab trials, the larvae feasted on leafy spurge. The insect must pass rigorous lab and field tests overseas and in this country before it can become another scourge for U.S. spurge. ARS scientists in Europe already have discovered, studied and shipped to their U.S. counterparts several anti-spurge insects including other moths, beetles, and flies. The goal: suppressing the weed with teams of insects to attack all its parts—roots, stems, leaves, flowers and seeds—throughout the year. *N. divisella* stands out as one of only two insects that bore into stems of spurge, and the larvae feed during the winter. The weed invaded the U.S. in the 1800's. Cattle won't eat it, it robs water that nutritious grazing plants need and it gives blisters and rashes to people who handle it.

*National Program Staff, Beltsville, MD*

*Richard Soper, (301) 344-2605*

**For the first time in 50 years, a new parasite of gypsy moths has made a permanent home in the U.S.** In the 1970's, ARS began importing the parasite, a wasp named *Coccygomimus disparis*, for studies and distribution. ARS scientists and cooperators freed more than 800,000 wasps to get it established in 16 northeastern and mid-Atlantic states. The main cooperators are the New Jersey Department of Agriculture, Pennsylvania Bureau of Forestry and Delaware State College. Last year, ARS collected and shipped the first *C. disparis* wasps from China after earlier collections in India, Japan and Korea. The slender inch-long wasp—10 times bigger than the typical parasitic wasp—doesn't sting people or animals. But one female can lay eggs in 200 gypsy moth pupae (the resting stage just before adulthood). Hatching wasp larvae then devour the pests. A bonus: if gypsy moths are scarce, the wasp switches to tent caterpillars or fall webworms.

*Beneficial Insects Introduction Research Lab,  
Newark, DE*

*Roger Fuester, (302) 731-7330*

*Asian Parasite Lab, Seoul, Republic of Korea*

*Robert Pemberton, 011-82-2-963-6561*

**When wandering gypsy moths try to set up house-keeping in an uninfested area, federal and state agents will have more ammunition—in the form of sterile males—to squelch the intrusion.** ARS researchers



found that by immersing gypsy moth eggs in the chemical KK-42 they could break diapause—the insect version of hibernation—after only 6 to 8 weeks of chilling instead of the normal 5 to 6 months. That would allow mass rearing facilities to produce up to three times more sterile males than currently possible. By timing the treatment just right, the sterile eggs will hatch just when the fertile eggs do—and they will emerge all at once instead of sporadically. More sterile moths mean more fruitless matings. KK-42 was developed in Japan as an insecticide and later found to break diapause of wild silkworm eggs. But ARS researchers found that it also can prevent gypsy moth eggs going into diapause altogether.

*Insect Neurobiology and Hormone Lab, Beltsville, MD*

*Robert A. Bell, (301) 344-1015*

A fungus that controls damping off diseases has been genetically altered in lab tests to resist the fungicide benomyl. If field tests are successful, farmers may one day use the fungicide and the bio-engineered fungus side-by-side to control a range of crop diseases. Benomyl kills the fungus *Gliocladium virens*, but adding a benomyl-resistant gene from another fungus creates a new strain of *G. virens* that allows it to withstand benomyl while still inhibiting the organisms causing damping off, or rotting. In tests the natural *G. virens* reduces plant loss to the disease by 80 to 95 percent—similar to control offered by chemical fungicides. Damping off rots seeds, seedlings and cuttings in cotton, beans, carrots, and other crops, costing more than \$1 billion a year. Meanwhile, benomyl offers excellent control of an-thracnose, fusarium wilt, leafspot, powdery mildew, and other diseases. And it is one of the fungicides still permitted by the Environmental Protection Agency. The Animal and Plant Health Inspection Service and the EPA must approve any field application of the new *G. virens* strain.

*Biocontrol of Plant Diseases Lab, Beltsville, MD*  
*Sue Mischke, (301) 344-4003*

A female, unisex wasp that kills alfalfa plant bugs triggered a mystery in University of Delaware research fields some years ago. The puzzle is now solved, and ARS scientists have released the unisex wasp—a previously unknown species not yet officially named—in other areas. This wasp can produce female offspring without mating. That means it can

build up its numbers and protect alfalfa—especially alfalfa grown for seed—more readily than wasps that must mate to produce female offspring. The mystery began in the mid-1980's, a few years after scientists freed European *Peristenus adelphocoridis* wasps at several alfalfa fields, including some on the university farm outside the ARS lab's back door. Puzzled, scientists wondered why 20 percent of the plant bugs in the "back door" fields had parasites—four times more than at other sites. These parasites didn't look like *adelphocoridis* or any native *Peristenus*—and more than 99 percent were female. All of the world's more than 50 identified *Peristenus* species attack the alfalfa plant bug or its damaging cousins. Scientists concluded that, except for the one-sided sex ratio, the mystery wasps closely resemble *P. rubricollis*, which ARS released at the university in 1978. They believe the new species was unknowingly imported and released along with *rubricollis*. It will take a few more years to know if the unisex wasp has taken hold in the new release areas in northern New Jersey.

*Beneficial Insects Introduction Research Lab,  
Newark, DE*  
*William Day, (302) 731-7330*

Living "pills" released a fatal dose of parasitic wasps for European corn borers in Iowa corn plots last summer. ARS is cooperating with Iowa State University and Pioneer Hi-Bred International in the first U.S. test of the capsules, called Trichocaps, developed in France. Made of gray cardboard and about the size of an oyster cracker, a Trichocap holds more than 500 eggs of the Mediterranean flour moth. Each egg holds an immature *Trichogramma maidis* wasp that feeds on the eggs. The Trichocap shields the wasps from predators and the environment until they exit through a tiny hole and search for mates. Females then hunt for corn borer eggs in which to lay their own eggs. In early results, scientists found 26 percent fewer borers in Trichocap plots than insecticide-treated plots. More study is needed to determine if Trichocaps can be effective and practical in the hotter climate and larger corn fields found in the midwestern United States. The Iowa test is part of a 2-year economic study comparing three natural controls—the Trichocap wasp, a bacterium (*Bacillus thuringiensis*) and a fungus (*Beauveria bassiana*). France's National Institute of Agricultural Research and National Union of Agricultural Suppliers developed the capsules.

*Corn Insects Research Lab, Ankeny, IA*  
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*Iowa State University, Department of Entomology,*  
*Ames, IA*  
*David Orr, (515) 294-7489*

## **New and Improved Products**

Mosquito relief for campers can be built into their tents. Permethrin, a widely used mosquito control chemical, lasts 6 to 9 months when applied to tent material—both in knocking down the total number of mosquitoes entering a tent and reducing the number of bites the people inside get. An ARS study found that people got either zero bites or very few for up to 9 months. Tents made of polyester with nylon-permethrin coating were kept outside for an entire year—an unlikely situation for the average camper or even military personnel. These results indicate that the chemical adheres to tent material so well that one treatment would probably last the tent's life. Thanks to previous ARS studies, permethrin is approved for application to civilian clothing in all 50 states. Since it was registered by the Environmental Protection Agency, permethrin is being used on U.S. military clothing and was widely available to troops in the Persian Gulf during Operation Desert Storm.

*Medical and Veterinary Entomology Research Lab,*  
*Gainesville, FL*  
*Carl E. Schreck, (904) 374-5968*

A new process to convert the fatty acids in vegetable oils for use in industrial products could open new markets for those oils. The new process subjects these fatty acids to high temperature and pressure to form estolides, which can be used as is, or split to form hydroxy fatty acids. Estolides are materials that are not now produced, but have potential applications in lubricants or cosmetics. Hydroxy fatty acids, now obtained from imported castor oil, are used in lubricants, plasticizers and cosmetics. Estolide yields from the new process are now less than 20 percent, but researchers are working to boost production to economically feasible levels. (PATENT)

*New Crops Research, National Center for*  
*Agricultural Utilization Research, Peoria, IL*  
*Robert Kleiman, (309) 685-4011*

**Rely, a new wheat variety for export markets, fights off rust diseases that plague other wheat**

plants. Rely is a club wheat, considered the highest quality type of soft white winter wheats. Grown only in Oregon and Washington, club wheats produce light, workable doughs favored for foods like cookies and Japanese sponge cakes. About 80 percent of the U.S. crop is exported to Asia. The new variety is unique because it fends off several different strains of stripe rust, unlike other club wheats that may withstand just one. That's because Rely contains a mixture of seven nearly identical lines of wheat. Each line resists one or two different strains of stripe rust. Also, most of the lines give Rely resistance to two other common wheat diseases—leaf rust and powdery mildew.

*What Genetics, Quality, Physiology and Disease*  
*Research Unit, Pullman, WA*  
*Robert E. Allan, (509) 335-3632*

**French fries made with Ranger Russet, a new potato variety, taste better** than those made with Russet Burbank, the industry's most popular variety. That's according to a panel of trained taste testers, who also gave Ranger high marks for color and texture. Ranger potatoes make crispier fries because they're higher in solids and so absorb less oil during deep frying. Processors like large potatoes with squarish ends, like Ranger, because they yield long french fries with less waste. The new spud also produces up to 28 percent more high-quality, U.S. No. 1 potatoes than the Burbank. Industry cooperators and state agriculture scientists from six states were involved with ARS in the testing and release of Ranger, which is available from certified seed growers in several states.

*Small Grains and Potato Germplasm Research*  
*Unit, Aberdeen, ID*  
*Joseph J. Pavek/ Dennis L. Corsini, (208) 397-4181*

**Keeping fruit flies out of fresh Hawaiian papayas** bound for the U.S. mainland is now easier and more economical for packers and shippers. After testing more than 51,000 papayas, ARS scientists won federal approval for a simplified, forced-hot-air process that allows packinghouses to fly-proof the fruit in bulk-bin loads of about 600 papayas each. The process requires no chemicals and doesn't damage papayas' taste or texture. Previously, the technique was approved only for single layers of fruit in boxes or trays—costlier and more time-consuming than the



bulk process. In the bins, papayas are gradually heated for about 6 hours with hot air kept at a relative humidity of 40 to 60 percent. This brings the fruit's temperature to 117 degrees F.—lethal to any oriental or Mediterranean fruit flies or melon flies that might be hiding inside. Heated fruit is later cooled with water. (PATENT)

*Tropical Fruit and Vegetable Research Laboratory,  
Hilo, HI  
John W. Armstrong, (808) 959-9138*

A promising new insecticidal dip that kills most floral-damaging insects may increase Hawaii's export market for cut flowers and foliage. Quarantine regulations require that floral products exported from Hawaii to Japan or to the mainland United States be insect free. Only a few registered pesticides exist to fight the numerous pests that attack tropical plants, which considerably limits the Islands' nursery industry. Cut flowers and foliages dipped for 5 minutes in a specially mixed insecticidal soap that included a synthetic pyrethroid insecticide came out insect-free without harming the plants. However, it is not recommended for anthuriums. Used as a postharvest treatment, scientists say the dip will help nursery products pass quarantine inspection. Components of the dip are available commercially. University of Hawaii scientists cooperated on researching the treatment which has been submitted to USDA's Animal and Plant Health Inspection Service for approval.

*Subtropical Horticulture Research, Miami, FL  
James D. Hansen, (305) 238-9321*

Juice of fresh guavas is now easier to extract from puree and use in carbonated beverages, juice blends or sparkling water drinks. That increases guava's versatility, and might open new markets for U.S. growers of this tropical fruit. They now produce about 20 million pounds of guava every year. Natural enzymes are exposed for 2 hours to guava puree that's heated to 122 degrees F. That process yields a clearer, thinner juice—and more of it—than other enzymes tried earlier. What's more, the juice is then easier to make into highly concentrated product with very little water in it. The enzymes, called pectinases, speed the natural breakdown of pectin, a component of fruit cell walls. Pectinases are already used in making clear juice from over a dozen other fruits such as apples, pears and pineapples.

*Tropical Fruit and Vegetable Research Laboratory,  
Hilo, HI  
Harvey T. Chan, Jr., (808) 959-9138*

Tomorrow's cookies, muffins and breads could be made from a crop that today feeds livestock and wildlife. Cattle, sheep and horses graze pastures and ranges of intermediate wheatgrass; rabbits and deer nibble on the plants' tender shoots. But ARS scientists found in taste tests that people liked the taste, texture and appearance of chocolate-chip oatmeal cookies, banana bread, and other baked goods made either exclusively with intermediate wheatgrass flour or a blend that included whole-wheat flour. As a perennial, wheatgrass could prove a useful alternative crop for growers with hilly, erosion-prone land that can't withstand the wear of seeding and tilling annual crops such as wheats, oats and rye. Wheatgrass produces new kernels each year, for 3 to 10 or more years, without replanting. However, it will not compete directly with commercial wheat—the only grain that can be made into a dough that rises and provides light, fluffy baked goods. To meet its potential for flour production, new wheatgrasses would need to be bred for a high output of kernels for milling, not lots of stems and leaves animals can eat. And markets and guidelines for millers and bakers would need to be developed.

*Food Quality Research, Western Regional  
Research Center, Albany, CA  
Robert Becker, (415) 559-5680  
Forage and Range Research, Northern Great  
Plains Research Lab, Mandan, ND  
John D. Berdahl, (701) 663-6445*

By growing new apple trees in 16-ounce jars—40 trees to a jar—researchers have found a way to trim the rising costs of orchards. Replacement apple trees grown by this tissue culture technique could cost growers under \$2 each compared to about \$5 for a tree grafted onto a rootstock. Tissue cultured trees (started from cells) grow on their own roots unlike other apple trees that must be grafted. Time from lab jar to the field is 4 or 5 months compared to about 3 years in a conventional nursery. ARS scientists are now working to dwarf these tissue cultured trees. From 600 to 1,000 dwarf trees could be planted on an acre of land that would sustain only about 150 regular size apple trees. Research is directed to identifying and possibly transferring the genetic trait that controls

dwarfing. ARS scientists are also studying growth regulators as a way to control dwarfing.

*Fruit Laboratory, Beltsville, MD*

*George L. Steffens, (301) 344-3567*

**The woolly apple aphid has met its match.** ARS scientists are effectively using a parasitic nematode and a new, systemic aphicide to control this aphid. Currently growers have no way of controlling this worldwide pest on apple roots. Native of eastern North America, the aphid causes damage by leaving honeydew on fruit, infesting apple cores, reducing tree vigor, attacking wounds on branches and tree trunks, and destroying roots. In field tests, the aphicide gave about 80 percent control; nematodes were significantly effective. The two new control methods can be used separately or together since the aphicide is not toxic to the nematodes, which are commercially available. The aphicide will soon be available.

*Appalachian Fruit Research Station, Kearneysville, WV*

*Mark W. Brown, (304) 725-3451*

**Abamectin, a natural product,** is being used for the first time to fight peachtree borers in Georgia's peach orchards. Currently, only one standard pesticide is recommended to control the borers, peach growers' number one insect problem. Derived from a soil microorganism by Merck Sharp & Dohme Research Laboratories, abamectin reduced egg laying and hatching, larval survival and adult mating of the insects. The natural insecticide does not harm plants or beneficial insects and can be used with integrated pest management practices. Peachtree borers cost Georgia growers about \$1.6 million annually; nationwide, about \$20 million. Abamectin is currently registered as an insecticide for use on citrus, cotton, and ornamentals.

*Southeastern Fruit and Tree Nut Research Lab, Byron, GA*

*Carroll E. Yonce, (912) 956-5656*

**Mushroom alert...**ARS researchers have found that penfluron kills the mushroom sciarid fly without damaging the mushrooms. Only two effective pesticides are registered for use against this fly, which is the principal insect pest of commercial mushrooms grown in North America. The pest has been known to destroy an entire crop of mushrooms. The limited

number of combatant compounds available increases the risk of the fly developing insecticide resistance. Researchers used penfluron at the rate of only 0.1 part per million. To be as effective, the other two chemicals must be used in concentrations of 30-to-50 ppm and 7.6 ppm, respectively. Using penfluron can reduce the cost of production, lower the amount of chemicals in the environment, reduce health risks, and lower the probability of the pest developing insecticide resistance. EPA has not yet approved the use of penfluron on mushrooms.

*Vegetable Laboratory, Beltsville, MD*

*William W. Cantelo, (301) 344-4557*

**Processed orange juice that tastes fresh squeezed is being commercially tested** by a juice processing company. Because of heat during pasteurization, it's almost impossible to keep the delicate balance of flavors in fresh orange juice. But by using gas chromatography, ARS scientists found a method to restore to processed juice the original mix of 20 flavor components in fresh juice.

*Citrus and Subtropical Products Research Lab, Winter Haven, FL*

*Philip E. Shaw, (813) 293-4133*

**Some 450 plumcot trees—crosses between a plum and an apricot—**are now growing in an ARS research orchard in California. Sweet-tasting plumcots, about the size of a small plum, are little-known. Today's plumcot trees typically produce too few fruit to be profitable for commercial growers, so ARS scientists crossbred highly productive plum and apricot trees as parents of the experimental trees. Among them are varieties from an ARS gene bank in northern California. Research goal: to have plumcots of the future boast the apricot's taste and have the plum's firmness. Also, plumcots would become available spring through fall, like plums but unlike apricots, which have one of the shortest harvest seasons of any stone (pitted) fruit. Plumcot's skin, soft and fuzzy as an apricot's, ranges from blond to ebony. The flesh can be orange, amber or even dark purple.

*Postharvest Quality and Genetics, Horticultural Crops Research Lab, Fresno, CA*

*Craig A. Ledbetter, (209) 453-3060*

*National Clonal Germplasm Repository, Tree Fruit and Nut Crops and Grapes, Davis, CA*

*Kathleen S. Rigert, (916) 752-6504*



Rambutan, an odd-looking but tasty fruit, might someday share the produce section with other tropical fruits like bananas and pineapples. ARS researchers are appraising unique rambutans that might appeal to U.S. growers and consumers. Rambutan looks something like a red or yellow egg sporting long, soft spines. The easily removed spines and peel cover translucent white flesh with crisp, juicy texture somewhat like a grape. The flavor is hard to describe but usually sweet, pleasant and mild. Seedlings of two unusual rambutans, sprouted from seed that ARS scientists collected in Borneo, are thriving at an ARS gene bank in Hawaii. One type, the giant rambutan (*Nephelium cuspidatum* var. *robustum*), yields fruit almost twice as large as the typical golf-ball-size rambutan. Another, a wild rambutan (*N. lappaceum* var. *pallens*), bears uncommonly dark purplish-red fruit with a sweet-tart taste. Native to Malaysia, rambutan can be eaten fresh—either alone or in salads or desserts—or canned, stewed or made into jams and jellies. Thailand exports \$2.5 million worth of canned rambutan fruit each year.

*National Clonal Germplasm Repository for  
Tropical and Subtropical Fruit and Nut Crops,  
Hilo, HI*

*Francis T.P. Zee, (808) 959-5833*

*Subtropical Horticulture Research Station, Miami,  
FL*

*Robert J. Knight, Jr./Raymond J. Schnell, Jr.,  
(305) 238-9321*

An experimental fruit has unusual parents—tropical passion fruit and maypop, a weed native to Maryland. About the size of a baseball with citrus-like flesh, the color of the new fruit's smooth skin ranges from greenish-yellow to purplish-green. It smells like a tropical passion fruit, and the sweet-sour tasting juice can be used alone or mixed with other juices. As yet unnamed, the fruit gets its cold-hardiness from the maypop weed. Field tests at Byron, Georgia look promising. It produces fruit from July until about November, or until frost, and seems fairly resistant to disease and insects. This potential alternative crop could be available to growers in 3 to 5 years.

*Subtropical Horticulture Research Lab, Miami, FL*

*Robert J. Knight, (305) 238-9321*

*Southeastern Fruit and Tree Nut Research Lab,  
Byron, GA*

## Soil, Water and Air

Dangling irrigation spray heads a foot above the ground enables farmers to put 96 percent of the water in the ground near crop roots. Known as low energy precision applicators (LEPA), these spray heads wasted the least water in tests for efficiency of water delivery. They were compared to spray heads suspended about 5 feet above the ground. Underground scales measured the pounds that soil gained when water was added. Conventional nozzles shoot an arc of water into the air at a force of 30 to 40 pounds per square inch. These nozzles wasted 15 to 20 percent of the water, which either drifted or evaporated before it struck the ground. Spray heads delivering water about 5 feet above ground, at pressures as low as 30 psi, wasted 10 to 15 percent. LEPA, using 6 psi of pressure, lost only 4 percent.

*Irrigation Water Management Research,  
Conservation and Production Lab, Bushland, TX  
Arland D. Schneider, (806) 378-5732*

Farmers could save hours of labor when they irrigate furrowed fields with a new irrigation tube that's really two tubes in one. The new system makes it easier for farmers to change irrigation from one section of the field to another—so water doesn't flow too long in one place. That means there's less chance of overwatering and subsequent soil erosion and leaching of fertilizer and other farm chemicals. Invented by ARS and an industry cooperator, the new tube is a type known as "layflat"—because that's what it does when it's empty. It can replace more cumbersome systems, like two separate tubes (one transfers water from the source to the field, and the other distributes water to furrows). It can also replace irrigation ditches, which require farmers to manually move siphon tubes to distribute water to individual furrows. Inside the new layflat tube is a flexible membrane controlled by a lever on a valve located between sections of the tubing. Pulling the lever moves the membrane from side to side within the tube: water either flows into furrows from outlets in the tube's side, or passes through the tube to an adjacent section of the field. Scientists successfully tested the new tube on 45 acres of barley, corn and alfalfa in southern Idaho; they plan tests on several crops in California. The co-inventor is currently working on ways to mass-produce the tubing for commercial use. (PATENT)

*Water Management Research, Kimberly, ID*  
*Allan S. Humpherys, (208) 423-6514*

**Chesapeake Bay oysters may benefit** from a new test designed to learn about tiny parasitic worms that attack crop roots. The worms—nematodes—cost U.S. farmers \$7 billion a year in chemical controls and damage to corn, soybeans and other crops. But some anti-nematode chemicals leach into groundwater and several have been taken off the market. So, ARS scientists want to find environmentally safe compounds to short-circuit the nematode's use of substances called sterols, which it gets from plants. Nematodes change sterols into cholesterol and other forms to grow new cells, make hormones and reproduce. With the new test, researchers identified 28 sterols in the corn root lesion nematode, including 9 found for the first time. The test—a modification of reversed-phase HPLC (for high-pressure liquid chromatography)—has fewer steps and is hours faster than current methods. Sterols also are vital to Bay oysters, which get them from green algae and, more importantly, brown-to-yellow algae known as diatoms. Excess nitrogen and other nutrients, entering the Bay in runoff, have favored growth of green algae over the diatoms. Marine scientists suspect—and are trying to determine whether it is true—that a change in the oyster's algal diet may be weakening its ability to resist diseases and pollution generally blamed for its decline. As part of the effort, University of Maryland and ARS scientists cooperated in adapting the ARS nematode-sterol test to discover the sterol makeup of seven common Bay diatoms. The information is helping scientists with the university, the National Oceanic and Atmospheric Administration and the state of Maryland. If they can learn how various algae species affect oyster health and nutrition, they can help lay a firmer scientific foundation for planning the oyster's comeback.

*Nematology Lab, Beltsville, MD*

*David J. Chitwood, (301) 344-3634*

*University of Maryland, Botany Department,  
College Park, MD*

*Glenn W. Patterson, (301) 405-1607*

**Plowing newspapers into the ground** might be the best way to grow crops and recycle newsprint, especially in the Southeast. In this region, a hard layer of clay soil, usually less than a foot from the surface, is a barrier to roots. Researchers created an ideal envi-

ronment for roots in this clay by filling 4-foot-deep trenches with a mix of 50 percent soil, 40 percent shredded newspapers and 10 to 15 percent chicken litter. Roots are able to draw in water from 4 feet instead of 6 inches. Each foot of soil in this area stores enough water to give plants the equivalent of an inch of rainfall. But scientists say trenching may only need to be 2 feet or less. They also are studying to see if the mixture will work on top of the soil. Fall leaves can be used to supplement or replace the newspapers and lawn clippings can do the same for chicken litter. Chicken manure, a waste product of poultry farms, "cooks" shredded newspapers so they decompose quickly. Next year, gypsum and fly ash—byproducts of coal-burning power plants—will also be used. Gypsum keeps hard clay soil from becoming cement-like and provides calcium. With further research, this method may become feasible for disposing paper waste and improving soil quality.

*Soil Dynamics Research, Auburn, AL*

*J.H. Edwards, Jr., (205) 844-3979*

**Millions of acres in the southern Mississippi River Valley** are covered with highly erodible soils. These soils often overlay subsurface layers that severely restrict plant-root growth. A 3-year study of topsoil depths ranging from 6 to 24 inches showed how erosion dramatically decreases crop yields. Average soybean yields were 36 bushels per acre for the 2-foot soil depth compared with only 26.8 bu/ac for 6 inches. As more and more topsoil erodes, crop yields decrease because plant roots must rely on moisture stored in soil above the subsurface layer. Thus, in low rainfall years, yields are much lower on shallow soils due to insufficient soil water. These findings show the necessity of using farming systems that will best control erosion and maintain at least 2 feet of topsoil. At shallower depths, yields and profits decrease and more fertilizer and lime are needed to keep the soil productive.

*National Sedimentation Lab, Oxford, MS*

*Fred E. Rhoton, (601) 232-2939*

**Soil losses from farms around Mississippi's Moon Lake** have dropped off significantly as farmers change to crops requiring less tillage. That has meant a cleaner, healthier life for the lake, a 4-square-mile body of water along the Mississippi River. An ARS study of farm practices and a 30-year record of sediment deposition document how less intensive



cropping practices can improve water quality. Scientists found that from 1954 to 1965, about 70 percent of the lake had more than 1 inch of sediment deposited each year. But then farmers switched from cotton to soybeans and rice which require less tillage. Over the next 20 years, about 86 percent of the lake had less than an inch of sediment per year. This is one of the first long-term studies that proves how changing to less intensive cropping practices can greatly improve the water quality and aquatic habitat downstream.

*National Sedimentation Lab, Oxford, MS*  
*Charlie Cooper, (601) 232-2935*

**Adding just 100 pounds of fertilizer for each surface acre of a farm pond that is deficient in nitrogen might clear up the cloudiness caused by clay.** Cloudy water in farm ponds throughout southern and central states is aesthetically displeasing and limits the pond's use for aquatic life. The nitrogen and phosphorus when added to cloudy water stimulates the growth of certain kinds of algae. As the algae grows and combines with the clay, they both settle to the bottom where they can be used as a food source for aquatic organisms. The treatment works fine when the right kind of algae called *Chorella* and *Anabaena* were abundant. It didn't work for two other algae. Previous solutions for clearing water—adding 1000 pounds per acre of gypsum or organic matter—were costly and impractical. More research is needed to find out what conditions will best favor the growth of effective kinds of algae and how long the clearing will last.

*Water Quality Research, Durant, OK*  
*Ron Menzel, (405) 924-5066*

**Cotton plants exposed to 63 percent more carbon dioxide grew more roots that also were longer and thicker than those growing without the elevated CO<sub>2</sub>.** Increases in root length increases from 18 to 60 percent, on average. Scientists increased the CO<sub>2</sub> concentration from the current 350 parts per million to 550 ppm, in field experiments in Mississippi and Arizona. If the rise in CO<sub>2</sub> continues as predicted, increased rooting could have far-reaching implications for farmers. It should help cotton plants take in more water and produce better yields in dry climates—yields increased by a third in Arizona test plants. But the extra roots could also attract more microorganisms in all climates. One question scientists will look at next year in Alabama is whether the increased rooting will cause an increase in disease organisms as well as

beneficial ones. Studies also will see if the new root growth could have beneficial effects for the environment by storing the increased carbon in the soil.

*Soil Dynamics Research, Auburn, AL*  
*Hugo H. Rogers, Jr., (205) 887-8596*

**A simple numbering system identifies for the first time the physical condition of soils.** Now everyone who works with soils will have a common index to refer to a soil's tilth—or a measure of its health—regardless of soil type. The new soil tilth index includes: bulk density (generally, the higher it is the smaller the pore space), cone index (soil strength affecting root penetration), organic matter content, uniformity of particle size (the greater the variety of particle sizes, the better the tilth) and plasticity (how soil reacts to water or its slipperiness and ability to support machinery). An index of 0.9 shows near-perfect tilth, while 0.2 indicates poor tilth. ARS scientists are continuing to collect and evaluate data. Soil's biological characteristics will be added later.

*The National Soil Tilth Lab, Ames, IA*  
*Tom Colvin & Tim Parkin, (515) 294-5724/6888*

## Human Nutrition

**Older women can actually increase bone density in their spines by getting extra vitamin D—the “sunshine” vitamin—during the dark days of winter in addition to getting adequate calcium, a study shows.** The lack of sunlight in the temperate zone from mid fall to mid spring leads to a deficiency in the vitamin, which helps the body absorb calcium and phosphorus from foods and deposit these minerals in bones. Researchers measured bone density in 247 women past menopause during a year-long study. In addition to getting 800 milligrams of calcium per day, half of the women got an extra 400 International Units (I.U.) of vitamin D, while the other half got a placebo. Both groups gained about the same amount of density in their spines during the summer and fall months when exposure to the sun prompts the skin to manufacture enough of the vitamin. And both lost density during the winter and spring months. But the group getting extra vitamin D lost only half as much. These women had an overall increase in spine bone of 0.85 percent for the year compared with no net gain for the placebo group. Unfortunately, 400 I.U. of the vitamin



is difficult to get from the diet, so vitamin supplements would be necessary.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Bess Dawson-Hughes, (617) 556-3064*

**Brisk walking several times a week along with extra calcium can help prevent osteoporosis**, according to a year-long study. A group of 18 women in their 50's and 60's walked at a pulse-raising pace for 45 minutes 4 times a week, while a second group of 18 maintained their sedentary lifestyles. Half of each group got an extra 800 milligrams of calcium daily to see if the mineral alone, or in combination with walking, could stem bone loss. Both paid off—but in different bones. The walkers actually increased spine bone by an average 0.5 percent during the year, while the sedentary women lost 7 percent, regardless of their calcium intake. Getting extra calcium, on the other hand, increased bone at the hip an average 2 percent in both the walkers and nonwalkers, compared to a 1.1 percent loss in those who got a placebo instead. That's good news for those who don't want to join the one-third of American women over 65 who have fractures of spinal vertebrae, or the one-third in their 80s who have hip fractures.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Miriam Nelson, (617) 556-3075*

**Milk is unlikely to interfere with the body's uptake of iron from cereals eaten at the same meal.** That is good news for women who are drinking more milk or consuming more of other calcium-rich dairy products to prevent osteoporosis. In an eight-week ARS study, eight young women volunteers either drank non-fat milk, or skipped it. The meals featured cereal products such as English muffins, whole-wheat hot cereal or brown rice casserole. Studies elsewhere had suggested that calcium in milk might limit iron absorption, but this didn't occur in the ARS study. The findings are also important for vegetarians and people who are eating less red meat. To avoid iron-deficiency anemia, such people have to make sure they get enough usable iron from their food. The iron they rely on—from grains and vegetables—is only one-fifth as absorbable as iron in red meat.

*Micronutrients Research Unit, Western Human Nutrition Research Center, San Francisco, CA*

*Judith R. Turnlund, (415) 556-5662*

**If eaten as part of a balanced diet, polyunsaturated fats—like those in vegetable oil—won't lower your levels of "good" HDL cholesterol.** That's a preliminary finding from a new 8-week study by ARS. HDL (high-density-lipoprotein) cholesterol is thought to lower the risk of heart disease. Earlier studies conducted elsewhere indicated that polyunsaturates might lower HDL—an unwanted effect. But in tests of 11 healthy, middle-age male volunteers, their HDL dipped slightly at the midpoint of the study but returned to original levels by the end of the experiment. Volunteers followed guidelines recommended by the American Heart Association: fats were no more than 30 percent of the day's calories and fat intake was balanced among three types—saturated, monounsaturated and polyunsaturated. Now the scientists are scrutinizing the other two kinds of fats, to determine which type lowers HDLs.

*Western Human Nutrition Research Center, San Francisco, CA*

*James M. Iacono/Rita M. Dougherty, (415) 556-5657*

**Stearic acid—a principal component of beef fat reported to reduce cholesterol levels—also helps the body absorb iron, even from plant foods.** Researchers have shown that this saturated fatty acid is at least part of the reason why beef fat enhances iron absorption better than other animal fats. They compared stearic acid or beef tallow—a rich source of the fatty acid—with safflower oil on iron-deficient rats. The rats that got stearic acid or beef tallow overcame their anemia and increased the amount of iron stored in their livers better than those that got highly unsaturated safflower oil. Women who tend to be anemic may be wise to keep some beef in their diets.

*Grand Forks Human Nutrition Research Center, Grand Forks, ND*

*Phyllis E. Johnson, (701) 795-8395*

**Vinegar and rice bran oil could become the salad dressing of choice for people who want to lower their cholesterol levels.** The latest findings of the oil's potential to lower cholesterol when substituted for saturated fat in the diet come from studies of monkeys by researchers with the University of Massachusetts, Lowell, and ARS. The oil is unique in that it contains all three substances—tocotrienol, oryzanol and ample amounts of plant sterols—known to either reduce circulating cholesterol or protect it from being oxi-



dized to a more damaging form. Researchers fed the monkeys about two tablespoons of rice bran oil alone and in blends with other oils, accounting for 35 percent of their total daily calories as fat. Rice bran oil alone produced the greatest reductions in cholesterol—up to 40 percent when the animals' levels were highest after eating a diet typical of U.S. diets. Only the damaging LDL cholesterol dropped, while the beneficial HDL cholesterol stayed constant or rose slightly. A second study confirmed the findings, showing that LDL cholesterol drops 1 percent for every 1 percent of rice bran oil in the diet. Results of controlled human studies are not yet available. Many grocery and health food stores carry rice bran oil, currently available only from Japan. Researchers are working to get domestic supplies of the oil.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Lynne M. Ausman, (617) 556-3163*

*Cardiovascular Research, University of Massachusetts, Lowell, MA*

*Robert J. Nicolosi, (508) 934-4501*

Evidence that a higher vitamin C intake may protect the eye's lens against cataracts is now more convincing. Researchers have shown that taking a large daily dose of the antioxidant vitamin increases its levels in people's lenses and in the fluid surrounding it—known as the aqueous humor. It is thought that higher concentrations of vitamin C in these tissues protects lens proteins from oxidation. That process damages the proteins, which then accumulate to cloud the lens. In a study of patients scheduled for removal of cataracts, 42 agreed to take either an extra 2 grams of vitamin C (ascorbic acid) or a placebo for at least 2 weeks prior to surgery. Those who got the supplement had 22 percent more ascorbic acid in their lenses and 32 percent more in their aqueous humor fluid than those who got the placebo. This was surprising because the placebo group reported an average ascorbic intake of almost 2.5 times the RDA of 60 milligrams per day—a level believed to provide adequate body stores of the vitamin. Ascorbic acid is far more concentrated in human lenses and aqueous humor fluid than in blood plasma, indicating these tissues actively take the vitamin from the blood. Apparently, an intake of 2.5 times the RDA still does not provide the optimal level in these tissues.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Allan Taylor, (617) 556-3155*

Even a balanced diet doesn't provide enough chromium—the essential trace element that helps regulate blood sugar. Analyses of institutional diets prepared by nutritionists and those freely chosen by study volunteers show that neither contained the minimum suggested intake. The average content of 22 balanced diets prepared at the Beltsville Human Nutrition Research Center was 13.4 micrograms (mcg) per 1,000 calories; it was 15 mcg/1,000 calories for diets study volunteers prepared at home. At these levels, a person would have to eat between 3,500 and 4,000 calories per day to get the minimum suggested intake of chromium—50 mcg. But the 11 women in one study actually consumed an average 2,273 calories per day, the 8 men 2,950. These levels are typical for Beltsville center studies. Breakfast cereals made with whole bran and those fortified with extra vitamins and minerals, including instant oatmeal, provide 10 to 30 mcg of chromium per serving. To get the maximum suggested intake—200 mcg—people would need a chromium supplement.

*Carbohydrate Nutrition Lab, Beltsville Human Nutrition Research Center, Beltsville, MD*

*Richard A. Anderson, (301) 344-2091*

More than one in five older Americans may need to take vitamin B<sub>12</sub> supplements to prevent neurological disorders and senility. These people no longer secrete enough stomach acid to absorb B<sub>12</sub> from foods as well as they used to. The condition, known as atrophic gastritis, affects at least 20 percent of people over the age of 60, increasing to about 40 percent of people over 80. A study of 16 subjects, half of whom had atrophic gastritis, showed that low acidity in the gastrointestinal tract impairs absorption of the protein-bound B<sub>12</sub> found in foods. But it does not impair absorption of the crystalline form used in supplements. Poor absorption of the vitamin may be responsible for age-related declines in balance and pressure sensation, in muscle coordination and in mental ability. However, the severe B<sub>12</sub> deficiency that leads to pernicious anemia is caused by other factors.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Robert M. Russell, (617) 556-3335*

Young men who eat 500 more calories a day than currently recommended for their age may be meeting their real energy needs. Researchers compared the actual energy burned by 14 healthy young men of

normal weight with the National Academy of Sciences estimates for energy requirements of young adult men, which are based on theoretical calculations. The volunteers, who followed their normal lifestyles during the study, all had sedentary full-time occupations, but exercised strenuously each day for a little more than half an hour. Test results showed that they required approximately 500 more calories than the recommended intake to maintain their weight.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*  
*Susan Roberts, (619) 556-3075.*

## **Crop Production and Protection**

Scientists are drawing genetic maps of corn and soybeans that will someday guarantee tailor-made food crops. Plant gene mapping can be compared to drawing an interstate highway map with roads that connect large cities. In the case of gene mapping, the "roads" are chromosomes; along these roads lie the "cities"—genes that control important traits such as disease resistance. So far, researchers have identified markers that pinpoint specific segments on chromosomes. This information will help geneticists combine desired segments, possibly shortening the plant breeding process by as much as 10 years. The result will be crops grown for specific markets, such as for high-energy animal feed, biodegradable plastics, and industrial products. The corn mapping project, a joint effort of the ARS and the University of Missouri, is part of a \$1 million, two-year project by USDA to create a base of genetic information for researchers and breeders to improve corn hybrids and other crop varieties.

*Plant Genetics Research, Columbia, MO*  
*Edward H. Coe, (314) 882-2768*

Exotic corn from Mexico might have the genetic stuff to help U.S. farmers stop a costly insect pest—corn earworms—without insecticides. The exotic corn, though unsuitable for commercial production, has comsilk so toxic to earworms that most of them die while munching on it. Breeding this trait into U.S. corn is a strong possibility, say ARS scientists. They've already identified the trace chemical that kills the earworms—it's called maysin. It occurs naturally in the silk, and has no known effect on humans or livestock. Now scientists are finding natural analogs (slightly different compounds) of maysin in other corn

lines. Such analogs could be used against earworms in case they become maysin-resistant. ARS scientists developed a chemical analysis technique to help breeders quickly determine the exact amount of maysin or maysin analogs in the comsilk of experimental lines. That should speed the breeding of commercial corn varieties with enough of the compounds—about 2 percent of the comsilk's dry weight—to do the job.

*Phytochemical Research, Athens, GA*  
*Maurice E. Snook, (404) 546-3579*

New beetle imports could blunt the Russian wheat aphid's 5-year invasion of U.S. grain crops. When the aphid attacks a wheat leaf, the leaf rolls up around it. That shields the pest from chemical spray and, scientists suspect, predatory lady beetles. But in Turkey in 1988, ARS scientists discovered *Scymnus frontalis*. More petite and easier to rear than common domestic lady beetles, it might do a better job hunting down aphids. ARS is supplying *Scymnus* colonies to USDA's Animal and Plant Health Inspection Service. In the 16 western states infested with Russian wheat aphids, APHIS released hundreds of thousands of lab-reared *Scymnus* and its cousins in 1990 and 1991. One cousin, the sevenspotted lady beetle, *Coccinella septempunctata*, is three or four times larger than *Scymnus* and can gorge on 100 to 250 aphids a day. ARS has imported and redistributed *C. septempunctata* since the 1950's. After scientists helped it take hold in the East in the 1970's, APHIS made massive releases of the insects, reared mostly from ARS colonies, in other areas. The sevenspotted, now in all 48 contiguous states, eats Russian wheat aphids, apple aphids, pea aphids, cereal aphids, greenbugs and other aphid pests.

*Beneficial Insects Introduction Research Lab, Newark, DE*  
*Paul Schaefer, (302) 731-7330*

Bacteria that cause plant diseases share a common trait with those causing chronic lung infections in cystic fibrosis patients. ARS scientists found that several types of *Pseudomonas* bacteria produce a compound called alginic acid while growing inside plants. This same compound is produced by another *Pseudomonas* species in cystic fibrosis patients. Scientists want to build on knowledge of the human infection in pursuing research to control the plant-infecting species, which can cause dead areas on plant leaves and rotting of fruits and vegetables. One



finding indicates that alginic acid forms a coating that may allow the bacteria to escape detection and protect them from certain plant defense mechanisms. Scientists say it may be possible to use specific chemical inhibitors to thwart alginic acid production or to genetically engineer plants to contain enzymes that can degrade alginic acid as it is formed by the bacteria during early infection. These enzymes are known to be produced by seaweeds as well as by certain microorganisms and marine animals.

*Plant Science Research, Philadelphia, PA*  
*William F. Fett, (215) 233-6418*

Forming a suction cup is how a recently uncovered bacterium begins its assault on microscopic worms called *Heterodora* nematodes. ARS researchers want to know if the bacterium could be an alternative to chemical nematicides that can pollute ground water. In preliminary tests by the Japanese scientists who first spotted the bacterium several years ago, it squelched reproduction of the pests in rice, soybean and potato fields. In recent cooperative studies with the Japanese, ARS researchers resorted to a novel anatomical analysis and found it to be a new bacterial species. With an electron microscope, they magnified it up to 30,000 times and detailed its appearance. They took this approach because the bacterium resists being cultured in the lab for the customary means of identification. Now it has a name—*Pasteuria nishizawae*. To grab hold of a nematode, the bacterium alters its teardrop shape to one resembling a suction cup. After it pierces the pest with a germination tube—a tactic common in fungi but rarely seen in bacteria—mobs of proliferating bacteria loot the nematode of nutrients. Progress is being made toward an effective culture medium—a prerequisite to testing the bacterium's potential. The experimental medium has more than 100 different vitamins, minerals, proteins and other ingredients.

*Nematology Lab, Beltsville, MD*  
*Richard M. Sayre, (301) 344-3039*  
*Insect Biocontrol Lab, Beltsville, MD*  
*Kevin J. Hackett, (301) 344-4325*

New clues about how insects fight infections have opened the way to using bacterial pathogens against them. In ARS studies led by the University of Nebraska, scientists uncovered chemical messages that trigger the immune response in the tobacco hornworm. This caterpillar is a large, easy-to-work-with relative of

several pests of corn, tomato and other crops. After injecting hornworms with inhibitors to block certain hormones, the scientists infected them with a natural bacterium, *Serratia marcescens*. Result: bacteria multiplied much more rapidly and the pests had a higher death rate. The experiment may lead to a novel, two-part insect control tactic: After insects would eat a bait laced with inhibitors to weaken their immune systems, they'd quickly fall prey to sprays of *Serratia* or other bacteria. The blocked hormones, known as eicosanoids, were known to control immune response and other physiological reaction in higher animals, but little had been known about their role in insects.

*Biological Research Unit, U.S. Grain Marketing Research Lab, Manhattan, KS*  
*Ralph W. Howard, (913) 776-2706*

Farmers can squeeze a few extra dollars from hilly pastures by slipping in a crop of icebox watermelons with the help of some black plastic cover. Normally, highly erodible hills should not be plowed for crops. But existing sod can be chemically killed, rototilled in narrow strips, and melons planted directly through a plastic cover that suppresses grass regrowth while melons are growing. The plastic keeps soil temperatures warmer and preserves vital soil moisture, so melons mature early. In field tests, researchers found 3 to 4 times the amount of ripe fruit present by the first harvest with plastic cover compared with planting in uncovered soil. The relatively high value of the melons compared with the income generated by raising animals over the same area gives hill farmers a way to make additional money and still have the option of growing forage for grazing later in the year.

*South Central Family Farm Research Center, Booneville, AR*  
*Donald J. Makus, (501) 675-3834*

An ARS-developed artificial flower is part of a novel system that attracts and kills female cabbage looper moths without harming the environment. The flower resembles a blossom of the tropical night-blooming jessamine shrub and has a glass capillary tube filled with sugar, an ARS-developed perfume resembling the real flower's scent, and an insecticide called methomyl. Adult females searching for nectar pick up the scent and spot the blossom. They insert their proboscis into the capillary tube, sucking up the deadly mixture—and avoiding any distribution of the insecticide into the environment. In flight tunnel



tests—in which adult insects must fly against a wind current to reach the scent and artificial flower—100 percent control was achieved. Every moth was attracted, fed on the dispenser, and died within several minutes. Results from field cage tests are being tabulated now.

*Insect Attractants, Behavior and Basic Biology  
Research Lab, Gainesville, FL  
Peter J. Landolt, (904) 374-5756*

Some of the succulent snap beans in the frozen-food section this winter will owe a big debt to scrawny pods of wild bean plants from South America. The wild plants hold genetic treasures being mined by ARS and cooperating university scientists to give farmers an alternative to chemical fungicides. After screening 3,600 wild strains, scientists found a few able to withstand devastating rust disease caused by *Uromyces appendiculatus* fungi. Fungal spores that look and spread like rust can destroy the leaves—and yields—of cultivated beans. The rust strikes in 55 different forms, or races; beans that resist some races can fall to any of the others. To solve the problem scientists crossed the wild and cultivated beans and released top-performing, super-rust-resistant lines to commercial breeders. One of the first commercial beans bred from the ARS lines is a new rust-resistant snap bean that is otherwise similar to the Slenderette variety.

*Microbiology and Plant Pathology Lab, Beltsville, MD  
J. Rennie Stavely, (301) 344-3564*

A natural compound called melanin enables fungi to attack crops. But now scientists have learned precisely how fungi make melanin—and they've found the same melanin-making process in more than 30 fungi, including several major pathogens of crop disease. Fungi often invade plants by forming probes that penetrate the plant's tissue. In some fungi, melanin must first build up in the cell wall of a specialized structure that grows from the fungus. This structure, an appressorium, then produces the probes that pierce the plant's tissue. Even when melanin isn't essential for fungal attacks on a crop, it still may be crucial to protecting the fungus from soil microorganisms or weather. Understanding the role of melanin in fungi gives researchers a new chance to find ways to interfere with the process and leave the fungi defenseless.

*Cotton Pathology Research, College Station, TX  
Michael H. Wheeler, (409) 260-9233*

**Mysteries can end** regarding which lance nematode is devouring the roots of a grower's fruit and field crops. That's because ARS has assembled the first definitive identification key for all 29 of these microscopic worms in the genus *Hoplolaimus*. These pests attack dozens of crops, but Extension agents can recommend a control strategy once they use the key to pin down the precise culprits. Nematode keys also are valuable to researchers worldwide for identifying pest species as well as searching for other, helpful nematode species, such as those that harass insect pests. Scientists at the ARS lab—the only one in USDA devoted exclusively to nematodes—have compiled or updated keys of many genera of nematodes. The lab also maintains USDA's historic Nematode Collection. It holds 31,000 slides and vials of 2,500 nematode species, including one collected in 1890 by Nathan Cobb, the USDA scientist known as the "father of nematology" in the United States. Last year, scientists in the U.S. and around the world sent the ARS lab more than 400 samples of nematode-infected plant tissue or soil for identification.

*Nematology Lab, Beltsville, MD  
Zafar Handool/Morgan Golden, (301) 344-3660*

**Kura, a clover species from Asia's Caucasus Mountains, may help protect riverbanks** and other sensitive riparian areas from cattle grazing. Kura was released by ARS, the Soil Conservation Service and university cooperators in 1988, but problems with establishment stymied seed production. Recent advances from intensive breeding work have yielded a new, improved Kura clover, ARS-2768, that should soon boost seed availability. The clover has extensive rhizomes, underground stems, that spread out sideways, providing soil stability—an important feature for protecting riparian areas. ARS-2768 Kura clover is adapted to mountain meadows, grasslands and foothill rangelands. Because it can withstand grazing, low temperatures, spring flooding and summer drought, it will likely benefit livestock producers and help protect the environment.

*Forage and Range Research Unit, Logan, UT  
Melvin D. Rumbaugh, (801) 750-3077*

**The microorganism which causes soft rot in Louisiana's sweet potato crop** is the same pathogen that causes the disease in Japan, ARS scientists have confirmed. Susceptible sweet potato varieties infected by the pathogen, *Streptomyces ipomoea*, develop sunken black blemishes, and the pathogen can also



cause root rot which eventually kills the plant. Samples of the pathogen were gathered from 29 locations across the United States and Japan to determine if the same microorganism is responsible for disease throughout the world. Several of the strains known to cause the infection were found to be genetically similar, indicating that the strains are of the same species. With this information, it's now possible to develop a genetic probe to detect the infective organism in soil. The findings may also be used to develop new soft-rot resistant sweet potato varieties.

*Microbial Properties Research, National Center for Agricultural Utilization Research, Peoria, IL*  
David P. Labeda, (309)685-4011

A mystery fungus that attacks cantaloupe grown in south Texas has been identified by ARS and Texas A&M University scientists. The fungus, identified as *Monosporascus cannonballus*, causes browning of the roots, stunting of vines and premature death of leaves on maturing plants. Infected cantaloupe are unmarketable due to smaller size, low sugar content and sunburn on the fruit skin. The fungus—which became prominent in Texas' lower Rio Grande Valley in 1986—reduced cantaloupe yields in some fields by as much as 50 percent. Fungicidal sprays failed to control this disease or other harmful soil-born fungi of cantaloupe. But now that it's identified, further studies should provide clues as to how to control the fungus. *M. cannonballus* also has been detected in Arizona and California.

*Genetics and Production Research Lab, Lane, OK*  
Benny D. Bruton, (405) 889-7395

Sugarbeets now resist a root disease that can't be controlled by chemicals. ARS scientists have turned over the new sugarbeet germplasm to plant breeders so they can incorporate its resistance into commercial varieties. The new beet germplasm is twice as resistant as current varieties to rhizoctonia root rot—a fungal disease that costs growers about \$50 million in lost sugar every year. Developed by ARS in cooperation with the Beet Sugar Development Foundation, the new germplasm produces as much sugar as today's commercial beets.

*Sugarbeet Production Research, Fort Collins, CO*  
Richard J. Hecker, (303) 482-7717

Young walnut trees growing in a northern California research orchard boast a gene that may thwart their insect enemies. That would enable growers to

use less insecticides in orchards and packers to use less fumigant to protect stored walnuts from attacks by the caterpillar offspring of several moths. Using a technique developed in cooperation with ARS, researchers at the University of California at Davis gave the trees a mothproofing gene borrowed from the soil-dwelling bacterium *Bacillus thuringiensis*, or Bt. The gene should enable trees to manufacture a Bt protein known to kill caterpillars of the codling moth, navel orange-worm and Indianmeal moth. ARS scientists will determine if the Bt gene is strong enough, or if biotechnologists need to experiment further. The Bt protein is harmless to humans and other mammals, as well as to birds, fish, many insects and other forms of life.

*Horticultural Crops Research Laboratory, Fresno, CA*

Patrick V. Vail, (209) 453-3000

*Department of Pomology, University of California at Davis*

Abhaya M. Dandekar/Gale H. McGranahan, (916) 752-0122

ARS scientists have pinpointed the fungus *Botryosphaeria dothidea* as the cause of peach tree gummosis. This serious disease, which decreases yields, attacks natural openings in the bark, causing blisters, sunken lesions, and gum seepage on peach tree trunks and limbs. It had been reported that three different species of *Botryosphaeria* were causal agents, but ARS research shows *B. dothidea* to be the troublemaker. Prevalent throughout the southeastern United States, the disease occurs in spring and early summer. This new discovery leads to a better understanding of the disease, which could lead to control measures.

*Southeastern Fruit and Tree Nut Research Lab, Byron, GA*

P. Lawrence Pusey, (912) 956-5656

Can a wild bee with a metallic green body mean more blueberries on growers' bushes? To find out, ARS scientists released over 1500 *Osmia ribifloris* bees, trapped in 7 locations in southern California, on a commercial highbush blueberry plantation. This bee's quick and efficient foraging technique is well-adapted for gathering pollen from bell-shaped blueberry blossoms. That's because the bees' first-choice pollen source is from manzanita, a blueberry-related species that has very similar flowers. In field observations, scientists saw female bees visit one blueberry flower every three seconds—about 3 times as fast as

worker honeybees. Preliminary studies showed excellent pollination success in fields of both highbush and lowbush blueberries, the two most prevalent types in the U.S. Drought in western North America has stymied additional trapping and testing of these wild bees, but future studies are planned to establish *O. ribifloris*' ability as a chief pollinator on blueberry plantations.

*Bee Biology and Systematics Laboratory, Logan, UT*

*Phillip Torchio, (801) 750-2520*

**A new dwarf daylily called Yellow Tinkerbelle has been developed** for use both as a perennial landscape border plant and a potted plant. Its height—only 9 inches—is the result of research to further miniaturize the dwarf daylily. The most popular dwarf variety is actually quite large, reaching a flowering height of 28 inches. The new dwarf is identical in all traits except size to one of the shortest daylilies which is 16 inches tall. Yellow Tinkerbelle has bright yellow, 2 1/2 inch flowers on the 9-inch stems, bearing about 7 flowers per stem. It will flower in a 4-inch pot in just 8 weeks after less than 12 hours of light daily at temperatures as low as 41° F. The new plant has survived temperatures of -15° F and will be available this fall.

*Florist and Nursery Crops Lab, Beltsville, MD*

*Robert J. Griesbach, (301) 344-3574*

**A dwarf variety of Lisianthus, or Prairie gentian, has been bred** for use as a potted or bedding plant. A native plant of the southern United States from Nebraska to Texas, most of the 60 named Lisianthus cultivars now available reach 3 feet before flowering and are grown for cut-flower production. To grow shorter plants for potting or bedding requires growth retardant. ARS scientists have developed Little Belle Blue, a new blue-flowered, dwarf lisianthus that is just 10 inches tall. Developed during tissue culture propagation of Dwarf Purple—one of the shortest cultivars that is 20 inches tall—Little Belle Blue will produce by early June up to 20 normal-sized flowers without pinching. Each flower lasts up to 2 weeks. The new plant was tested from 1986 to 1988 for dwarfness, ease of growth and flower quality. A limited supply of seed is available.

*Florist and Nursery Crops Lab, Beltsville, MD*

*Mark Roh, (301) 344-3570*

**Blue spruce may get a better start in life** from tiny amounts of an experimental compound. ARS scien-

tists soaked spruce seeds for 6 hours in the compound, known as DCPTA or 2-(3,4-dichlorophenoxy) triethylamine. After 8 months in a greenhouse, the seedlings of this popular landscaping and Christmas tree were 51 percent taller than those that didn't get the DCPTA. They also had three-and-one-half times more branches and 37 percent more root growth. Scientists say the compound, which they have patented, likely accelerates photosynthesis—the tree's conversion of sunlight into food energy. Blue spruce is one of more than a dozen crops the researchers have tested. Earlier experiments yielded jumbo radishes, sugarbeets that contain more sugar, lemons richer in lemon oil essence and bumper crops of tomatoes, beans, corn and cotton. Scientists in Southeast Asia are testing DCPTA to see if it will boost growth of teak seedlings needed to replant denuded rainforests.

*Fruit and Vegetable Chemistry Laboratory, Pasadena, CA*

*Henry Yokoyama, (818) 796-0239*

## **Animal Production and Protection**

**A more sensitive and accurate test to detect listeriosis in cattle** is under development by ARS researchers. *Listeria monocytogenes*, the organism behind listeriosis, causes encephalitis, abortion, and sometimes mastitis in dairy and beef cows. Current detection methods produce many false positive results. Now researchers can use a test that detects antibodies in cow's blood to listeriolysin O—a protein found only in pathogenic strains of *Listeria*. With this test, researchers followed the changes in anti-listeriolysin antibody levels during the course of infection in 19 lab-infected dairy cows for more than a year. *L. monocytogenes* also can be found in milk and meat products, but is destroyed during milk pasteurization or cooking. In humans, listeriosis is a potentially fatal intestinal disease and is most prevalent among pregnant women, unborn fetuses, and other persons whose immune systems are not properly functioning.

*National Animal Disease Center, Ames, IA*

*Albert L. Baetz and Irene V. Wesley, (515) 239-8385*

**A bacterium from a cow's rumen may help lower feed costs** for dairy farmers. The natural bacterium *Streptococcus bovis* could be added to bacterial inoculants now used by dairy farmers to lower pH in silage. Researchers have found that when *S. bovis* is added, silage pH drops as much as 50 percent faster than with the inoculant alone. As pH declines, enzyme



and microbial activity in the silage is halted, saving nutritious protein and carbohydrates in the feed. The combination of *S. bovis* and commercial inoculants could improve silage quality enough to allow farmers to cut costly supplemental feed purchases.

*U.S. Dairy Forage Research Center, Madison, WI*  
*Richard Muck, (608) 264-5245*

**Ultrasound testing to detect if a cow is carrying twins** can give cattlemen the "inside information" they need to plan for the cow's special needs. Researchers report they've increased survival of twin calves by about 10 percent by checking cows with ultrasound. About 35 percent of calvings involving twins require human assistance, compared with about 15 to 20 percent of single-calf births. Also, cows carrying calves may take longer to rebreed under typical production systems. That's because the pregnant cow's body cavity is so full of fetuses that there literally isn't room for her to eat enough of a normal low-energy diet to increase the level of physical condition to rebreed quickly.

*Reproduction Research, Clay Center, NE*  
*Sherrill E. Echternkamp, (402) 762-4183*

**A surrogate cow's uterus is more than just "rented space,"** researchers say. Studies indicate the breed of the surrogate mother can affect the development of the gestating calf, even if the calf is a different breed. Fertilized eggs from purebred Brahman parents were implanted in Charolais cows, while fertilized eggs from purebred Charolais parents were placed in Brahman cows. In addition, some Charolais eggs were put into Charolais mothers, and Brahman eggs were implanted in Brahman mothers. When the fetuses were checked for development at 270 days of gestation, Charolais calves inside Charolais mothers weighed about 28 pounds more than Charolais calves inside Brahman mothers. And Brahman calves inside Charolais mothers weighed about 11 pounds more than Brahman calves in Brahman mothers. Researchers think the difference is the Brahman mothers' lower uterine blood flow to the growing fetus.

*Nutrition Research, Clay Center, NE*  
*Calvin L. Ferrell, (402) 762-4205*

**Salmonella bacteria can't digest certain naturally occurring sugars** found in wheat, onions and garlic, so researchers are combining these sugars with different, harmless bacteria in chicken feed. The combination literally crowds out intestinal *Salmonella* in young

chickens. The sugars—known as fructoooligosaccharides or FOS—make a chicken's intestines inhospitable for the "bad" bacteria while encouraging growth of the "good" bacteria, which naturally occur in the chicken's intestines. As a bonus, researchers say, FOS could replace antibiotics now added to feed to promote growth in the birds. Scientists aim to develop a system based on FOS to reduce *Salmonella* in young chicken flocks.

*Poultry Microbiological Safety Research, Athens, GA*  
*Joseph S. Bailey, (404) 546-3356*

**Accurate food-safety tests for processed meats** are simpler with a new ARS "soup" in testing for two major food-poisoning bacteria. Each year, the food industry runs about 7 million tests for *Salmonella* and 4 million for *Listeria*. But with the new ARS-patented broth or growth medium, companies can run the same number of tests with half as many preparatory steps. That could save the industry \$5-\$7 million a year with no loss in accuracy. The current preparatory steps require processors to incubate food samples for 24 hours in two separate broths—one for *Salmonella* and one for *Listeria*. With the new medium, both bacteria can be incubated together. The preparatory step is followed by incubation in a separate broth specific for each pathogen. (PATENT)

*Poultry Microbiological Research, Athens, GA*  
*Stan Bailey, (404) 546-3356*

**Cattle grazing on fescue infected with a natural pathogen** called a fungal endophyte can suffer from poor blood circulation, resulting in loss of ears, tail tips and even feet. Now field tests have shown that cattle eating infected fescue may have more amylase in their blood serum. Elevated levels of serum amylase could be an indication of pancreatitis, which can cause chronic gastric pain and may reduce how much the animal eats. In the field tests, Angus-sired yearlings grazing endophyte-infected fescue showed significantly higher blood levels of serum amylase than did their contemporaries on common bermudagrass that did not contain the endophyte. Brahman-sired yearlings from Angus dams were numerically higher in serum amylase on fescue compared to bermudagrass, while straightbred Brahman yearlings were similar on both forages.

*South Central Family Farm Research Center, Booneville, AR*  
*Michael A. Brown, (501) 675-3834*



Feeding cattle mineral supplements will not curb their appetite for poisonous larkspur, according to a four-year ARS study. This perennial, purple-flowered plant fatally poisons thousands of cattle each year. The study also disproved another hypothesis—that the supplements cause cattle to drink more water, thereby hastening excretion of the poison. Cattle did drink more during one year in the study, but samples of fluid from the cow's rumen (the first stomach compartment, where digestion begins) did not show increased dilution of the larkspur poisons. ARS researchers have concluded that if the mineral supplements do indeed help reduce cattle losses due to larkspur, other, unknown mechanisms may be responsible.

*Poisonous Plant Research Unit, Logan, UT  
James A. Pfister, (801) 752-2941*

Annoying houseflies around dairy farms were reduced up to 65 percent under a pilot program conducted in Maryland and New York in 1988. As the suburbs move out to the "country," complaints of flies spreading from dairy farms to nearby homes increase. Also, milk inspectors will not grant grade A milk status to farms with too many flies. Under a cooperative program administered by ARS and Cornell University, farmers released about 12,000 parasitic wasps weekly over a 16-week period to attack fly pupae. They also cleaned calf pens weekly, since manure in the pens is a major breeding ground for the flies. Small amounts of pyrethrin, an environmentally safe insecticide, were also used against the flies. Relatively little fly control was attained on farms where the insecticide alone was used. This program may lead to a fly control system that is both economical and environmentally safe for dairy farms—and nearby residents.

*Livestock Insects Lab, Beltsville, MD  
Richard W. Miller, (301) 344-2478*

A cattle breed from St. Croix could offer subtropical cattlemen a choice besides the heat-tolerant Brahman breed. In studies comparing heat tolerance capabilities, Senepol cattle performed as well as Brahmans, which are a mainstay of the Florida cattle industry. Heat tolerance may translate into longer daily grazing times—and more opportunity to gain weight. The study compared Senepol, Brahman, Angus and Hereford cows and heifers plus Senepol, Hereford and Senepol-Hereford crossbred calves under summer grazing conditions in central Florida. The

Angus and Hereford generally had higher rectal temperatures than the Brahmans and Senepols, a sign of less heat tolerance. Mean daily grazing time was longer for the Senepols at 10.7 hours, compared with 9.3 hours for Hereford cows. Senepol cattle have not been widely produced so far in the continental United States. The Senepol breed was developed on St. Croix at the turn of the century from a blend of the African N'Dama breed and the English Red Poll breed.

*Subtropical Agricultural Research Station,  
Brooksville, FL*

*Andrew C. Hammond, (904) 796-3385*

## **Scientific Information Systems**

Erosion is greatly influenced by soil wetness, so an accurate evaluation of how much water is in the soil is critical in planning soil conservation programs. A computer model called HYDRO, a component of the Wind Erosion Research Model, or WERM, can track water movement in and out of the soil on a daily basis. HYDRO also provides hourly estimates of the wetness of the soil surface. Field studies show the model's predictions of soil-water content and daily soil evaporation rates match actual measurements. Researchers say the model will be a valuable tool to predict soil wetness as needed. WERM is the first phase of the Wind Erosion Prediction System, a likely candidate to replace the wind erosion equation currently used in conservation planning.

*Wind Erosion Research, Manhattan, KS  
Edward L. Skidmore, (913) 532-6726*

How do pesticide and fertilizer compounds bind to soil particles in a crop field? To fully understand and predict chemical-soil interactions, scientists need to know the number and location of binding sites on the surfaces of the particles. They now can do this with an imaging technique commonly used in medical diagnosis but adapted by ARS scientists to soil research. It's called multiple-quantum nuclear magnetic resonance (NMR) spectrometry. Scientists can better predict if, when and how much farm chemicals will leave a field in storm runoff or will leach through the soil to ground water. Such analysis, based on data from multiple-quantum NMR studies, should boost the accuracy of computer models used to gauge environmental impacts of pesticides and fertilizers.

*Eastern Regional Research Center, Philadelphia, PA*

*Walter V. Gerasimowicz, (215) 233-6439*



Overgrazing of rangeland can be prevented with a new computer program called SMART—for Simple Model to Assess Range Technology. Smart accurately matches the number of yearling cattle to the available forage. A rancher's stocking rate, initial weight of steers, total annual forage production, and dates of grazing are entered in the computer. Then SMART prints out forage supply and gains for each day and the totals for the grazing season. It's possible to try several stocking rates and levels of forage production so ranchers can evaluate the results and potential income and then decide which alternative to adopt. More than 300 ranchers, extension agents and others have obtained copies of the program, available free from ARS scientists.

*High Plains Grasslands Research Station,  
Cheyenne, WY*

*Richard H. Hart, (307) 772-2433*





# Quarterly Report of Selected Research Projects

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## Human Nutrition

Senior citizens who filled up on breakfast fare—milk, cereal and fruit—had the highest intakes of trace elements and the best nutritional status among 680 Boston area residents studied. Researchers analyzed 3-day diet records prepared by the volunteers for the foods that contributed the most calories in their diets. Of the four major eating patterns that emerged, a diet high in milk, cereal and fruit provided the best nutrition. This group was predominantly women. By contrast, a diet high in meat and potatoes was least nutritious. This group—which was predominantly men—had the lowest intakes of trace elements and the lowest blood levels of folate and vitamin B<sub>6</sub>. A third group that consumed a lot of bread and poultry had the lowest caloric intake among the four groups but, paradoxically, had the highest body mass. And the group of high alcohol consumers—mostly men—had

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work.

Items marked with the word PATENT are being patented by ARS. For more information contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, Beltsville Agricultural Research Center, Beltsville, MD 20705, (301) 504-6786.

the lowest blood levels of riboflavin and vitamin B<sub>12</sub>, but the highest levels of HDL cholesterol, the beneficial kind.

*Human Nutrition Research Center on Aging at  
Tufts, Boston, MA  
Katherine L. Tucker, (617) 556-3351*

Shift work may raise cholesterol levels in addition to upsetting people's gastrointestinal tracts and depriving them of sleep. That was the result of a study of rats subjected to variable light and dark cycles. The findings may help explain why shift workers seem to have more cardiovascular disease than day workers. At the end of 6 weeks, cholesterol was 24 percent higher in the group of rats subjected to changing light-dark cycles simulating 8-hour shift work. That compared to a control group on a constant light-dark cycle of 12 hours each. A third group of rats was subjected to a low-copper diet—a known elevator of cholesterol—along with the changing light-dark schedule. These animals had cholesterol levels 70 percent above the control group.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Leslie M. Klevay, (701) 795-8464  
Dept. of Psychology, University of North Dakota,  
Grand Forks, ND  
Edward S. Halas, (701) 777-3260*

Some Houston infants will be eating their greens in the form of specially grown alga. Researchers plan to use the alga, *Spirulina*, to see if infants can make certain amino acids on their own or whether the nutrients have to come from the diet—and, if so, at what age. In this alga, about 97 percent of the carbon atoms are the heavier, nonradioactive <sup>13</sup>C compared with 1 percent found in everything else on Earth. Using such a uniformly labeled food source is like attaching a video camera to each amino acid (or any other carbon-containing nutrient for that matter) and following its travels through the body—without any harm to the infant. Before using it in human studies, researchers fed the alga to a hen and found, to the surprise of chicken experts, that the amino acid proline was essential—at least under their experimental conditions. The researchers then fed it to several

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women and demonstrated, not surprisingly, that the volunteers synthesized more amino acids when they fasted. What's more, they were able to "see" how quickly the amino acids were absorbed from the alga and how quickly they became incorporated into a blood protein. The *Spirulina* was grown in a closed system with "heavy" carbon dioxide by a private company in Columbia, Md.

*Children's Nutrition Research Center, Houston, TX  
Peter D. Klein, (713) 798-7000*

**Twenty million living colon cells can now be isolated from a small stool sample** using ordinary laboratory equipment. The new technique is noninvasive and can be done repeatedly, enabling researchers to study the effects of various diets on colon tissue over time. ARS researchers developed a chemical solution that protects the cells from breaking apart and provides sugar to keep them viable as the stool sample is homogenized, filtered and then spun in a centrifuge. Collaborators with Johns Hopkins University in Baltimore, Md. were able to separate precancerous cells from normal ones and immune cells from colon cells using antibodies that bind to specific proteins on the cells' surfaces. If validated in clinical tests, it also may allow physicians to diagnose early stages of colon cancer or gauge colon inflammation without touching the patient. Currently, patients must undergo colonoscopy—visual inspection and removal of colon tissue—which requires hospitalization and causes discomfort. The surgically removed cells come from limited areas, but those isolated from the stool are more useful because they represent the entire colon surface.

*Lipid Nutrition Lab, Beltsville Human Nutrition  
Research Center, Beltsville, MD  
Padmanabhan Nair, (301) 504-8145*

**Dried parsley flakes—sprinkled generously on main dishes and salads—could add small but significant amounts of several essential trace elements to your diet.** The flakes are also a source of prospective elements such as molybdenum and boron. On a gram for gram basis, parsley flakes had 2 to 3 times more copper, iron, magnesium, molybdenum and boron than any other food product among 52 items analyzed. And the flakes scored second in zinc and manganese. However, it takes a little more than 2 teaspoons of

parsely flakes to make one gram. How well the minerals in parsley flakes are absorbed compared to other foods needs to be determined.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Curtiss Hunt, (701) 795-8423*

**Moderate amounts of corn bran in a well-balanced human diet** seems to have little effect on mineral absorption. Tests with pigs, which have digestive systems similar to humans, show that high dietary levels of corn bran bind calcium in the upper digestive system, making it unavailable for absorption. But when the pigs were on diets containing recommended amounts of both bran and calcium, the corn bran did not influence calcium absorption. Potassium and sodium absorption also were largely unaffected by the corn bran.

*Food Physical Chemistry Research, National Center  
for Agricultural Utilization Research, Peoria, IL  
Joseph A. Laszlo/Frederick R. Dintzis, (309) 685-4011*

**Food labeling will benefit from a tannish powder** representing the total American diet. Just as U.S. clocks are set to the National Institute of Standards and Technology master clock in Boulder, Colo., laboratories analyzing foods for nutrient content need a primary food standard against which to check their values. The powder—officially known as Standard Reference Material (SRM) 1548—is certified by NIST for concentrations of 13 essential trace elements and values for fat, cholesterol, fiber, ash, calories and Kjeldahl nitrogen—a measure of protein content. Researchers with ARS, NIST and the Food and Drug Administration developed the standard using foods from FDA's Total Diet Study. On sale since October 1990, SRM-1548 is a best seller despite its high cost—\$251 for less than half an ounce. It enables laboratories to ensure the accuracy of their analytical methods and validate secondary reference materials used in day-to-day quality control.

*Nutrient Composition Lab, Beltsville Human  
Nutrition Research Center, Beltsville, MD  
Wayne R. Wolf, (301) 504-8927  
Nutrient Surveillance Branch, Food and Drug  
Administration, Washington, DC  
James T. Tanner, (202) 472-5364*



## **New and Improved Products**

**New tomatoes from ARS stay on the vine but don't ripen until desired.** This could lead to fresher tomatoes at the supermarket year-round. The new fruit, genetically engineered by researchers, could also reduce spoilage and refrigeration costs that get passed to consumers. The researchers say the approach looks promising for many highly perishable fruits and vegetables, as well as for cut flowers. Scientists engineered the tomatoes to block production of ethylene, a compound that causes ripening. They did this by rebuilding a gene and reversing its message—leaving the tomatoes unable to turn out a crucial enzyme for making ethylene. This tactic, known as “antisense RNA,” stopped 99.5 percent of ethylene production in about 100 greenhouse-grown tomatoes. Later, when exposed to ethylene, the tomatoes ripened and softened, taking on the texture, color and firmness of a vine-ripened crop. (PATENT APPLICATION 07/579,896)

*Plant Gene Expression Center, Albany, CA  
Athansios Theologis, (510) 559-5900*

**Waste disposal problems related to vegetable oil refining can be solved** with a process called supercritical fluid extraction. Bleaching clay is now used to purify vegetable oils and then is typically disposed of either in a landfill or treated with chemicals to extract any remaining oil from the clay. But oil-saturated bleaching clay in landfills is prone to spontaneous combustion on hot summer days, and chemical treatments to extract the oil result in chemical residues that require special disposal methods. However, carbon dioxide, a non-flammable and non-toxic substance, can be heated and pressurized to an intermediate state between a liquid and gas and used as an extraction medium. In this supercritical state, carbon dioxide extracts 100 percent of the oil from the bleaching clay. The extracted oil is suitable for industrial applications, and the clay can be reused to refine more vegetable oil, saving landfill space and eliminating potential environmental hazards.

*National Center for Agricultural Utilization Research, Peoria, IL  
Jerry King/Gary List, (309) 685-4011*

**A license to produce a low-fat milk concentrate** developed and patented by ARS scientists has been granted to a major manufacturer of infant formula.

Mead-Johnson Nutritional Group of Evansville, Ind., is studying various uses of the concentrate, which has the texture of whole milk but the cholesterol content of skim milk. Past attempts to concentrate dry whole milk resulted in difficulties in reconstituting the butterfat. But ARS scientists found that combining non-fat dry milk with a critical level of water, then blending cholesterol-free oil—such as soybean, corn or peanut oil—overcomes the need for emulsifiers and homogenizers to avoid oil separation. An eight-ounce serving of whole milk contains 33 milligrams of cholesterol compared with just four milligrams found in the milk from concentrate. Also, the concentrate, which can be frozen, occupies about 75 percent less storage space than fluid milk. (PATENT 4,842,884)

*Food Quality and Safety Research Unit, National Center for Agricultural Utilization Research, Peoria, IL  
George Bookwalter, (309) 685-4011*

**Designing soft wheat varieties with specific traits** to produce consistently tender cookies, crackers and cakes is the goal of a research and development agreement between ARS and the Nabisco Biscuit Co. of East Hanover, N.J. The agreement is an outgrowth of the 1990 Farm Bill. If baking companies can buy wheat with the qualities they want, it could reduce losses when the flour doesn't satisfy their quality standards. Scientists are studying genetic and environmental factors that affect flour quality and product texture. Also, various chemical and physical properties in wheat varieties now grown and sold to the baking industry are being reviewed to find which varieties consistently produce the best results for different food products. Ultimately the research results will be given to plant breeders who can design varieties with the best characteristics for different kinds of food products. It also could give the United States an edge in the competitive wheat export market by offering international bakers a more desirable product.

*Soft Wheat Quality Research, Wooster, OH  
Patrick Finney, (216) 263-3890*

**A type of corn hybrid known as “flint”** is showing good yields in test plots—and that's good news for corn flake makers and consumers. ARS and Pfister Hybrid Corn Co. of El Paso, Ill., evaluated 15 corn hybrids including dent, flint, and dent-flint crosses. In most cases, the flint genotype yields harder corn from which more and larger corn flakes can be made. In

shipping, this harder corn is less likely to break, chip or crack. Corn growers typically have planted only the common yellow dent-type corn because of its higher yields. But in the test plots, the flint genotypes and flint crosses showed yields equal to common yellow dent corn.

*Food Safety and Quality Research, National Center for Agricultural Utilization Research, Peoria, IL  
Al Peplinski, (309) 685-4011*

**Subjecting mature green tomatoes to heat delays ripening** and softening. Such results—in ARS experiments—are contrary to the established practice of storing green tomatoes at temperatures between 57 and 60 degrees F to retard the ripening process. ARS scientists put the green tomatoes in storage at about 104 degrees F for four days. Then the fruit was stored at room temperature of about 70 degrees F. After 10 days, treated tomatoes were still firm, just beginning to ripen with a slight red color. Untreated fruit were blood red and completely ripe so that they were susceptible to bruising and decay. By delaying fruit softening, the new heat treatment could cut tomato losses during shipping and lengthen shelf life in stores.

*U.S. Horticultural Research Lab, Orlando, FL  
Elizabeth J. Mitcham, (407) 897-7323*

**An "environmentally friendly" method of curing leather** also extends its strength and elasticity. ARS scientists are preserving hides with electron beam irradiation to replace the salt or "brine" solutions now used to kill bacterial growth. Electronic beam irradiation currently is used to sterilize prepackaged bandages and surgical dressings. It uses the same sort of electronic beam that converts broadcast signals from the atmosphere into a picture on the television screen. Accelerating electrons to very high speeds and subjecting hides to these electrons destroys the bacteria's DNA, prohibiting growth. Hides placed on a moving belt pass under the beam, which penetrates deeply into the hide. Hide samples in the laboratory have been preserved for at least 5 years. Using the electron beam irradiation technology would greatly reduce the environmental impact of current tanning procedures. Brine curing is not only corrosive to equipment, but contributes to water pollution. Approximately one gallon of brine is released into the environment for every hide cured. When these hides are received by the tanner they contain as much as 14 percent salt, which is

removed by soaking and results in a second salt-solution waste.

*Hides, Leather and Wool Research, Eastern Regional Research Center, Philadelphia, PA  
David G. Bailey, (215) 233-6486*

**A dip in a hot water bath containing the fungicide imazalil protects mangoes** against anthracnose, a postharvest fungal disease that destroys stored fruit. Mangoes are picked at an immature stage and ripen in storage. The fungus exists undetected until storage temperatures are raised to enhance ripening. Because the crop is small (\$4.4 million), no approved chemical control is available. In two-year tests on three varieties of mangoes, scientists with ARS and J.R. Brooks & Son Inc. reduced anthracnose 88 percent with the hot water dip. Further research is needed to meet regulatory requirements for EPA registration of imazalil on mangoes. The fungicide is already approved for use against postharvest decay on citrus and for use as seed treatment of wheat, barley, and cotton.

*Subtropical Horticulture Research, Miami, FL  
Raymond G. McGuire, (305) 238-9321*

**Goldenrod weed, yeasts or bacteria could supply premium natural rubber** if scientists can bioengineer them to accept rubber-producing genes. This might lessen America's dependence upon imports and petroleum-based synthetics. But the first big step will be finding key genes in the rubber tree (*Hevea brasiliensis*) or in the slow-growing desert shrub guayule (*Parthenium argentatum*). Now, ARS scientists are taking a shortcut in this search by adapting a time-saving technique that lets them isolate rubber particles from these plants. Called centrifuge flotation, the technique is cleaner, faster and easier than relying on gel-like filters. Rubber tree latex is mixed with an alkaline chemical in a test tube, then spun in a centrifuge at 4,000 times the force of gravity for 10 minutes. This makes rubber particles float to the top of the test tube. Attached to the particles are proteins and enzymes that may lead the scientists to the genes they're looking for. In 1990, the United States imported almost a million tons of natural rubber, in some years worth nearly \$1 billion, for products like auto tires, which are a blend of natural and synthetic rubber.

*Process Biotechnology Research, Western Regional Research Center, Albany, CA  
Katrina Cornish, (510) 559-5950*



**A new ARS-bred hop variety called Liberty adds to beer the desirable aroma** of its parent, a popular German hop called Hallertauer mittelfruh. But Liberty isn't troubled by the disease problems that have all but wiped out Hallertauer plantings in Europe. Yields of Liberty, which thrives in the temperate Pacific Northwest, are double that of the Hallertauer. Liberty and Mount Hood, another Old World-style hop released 2 years ago, may reduce American brewers' reliance on imported hops and help them find export markets. Six major breweries—3 in the U.S., 2 in Canada and one in Japan—are all interested in Mt. Hood hops. Also, the small but growing microbrewery business is another market for the new hops. Washington, Oregon and Idaho grow about 58 million pounds of hops a year, second to Germany in hop production.

*Forage Seed and Cereal Research, Corvallis, OR  
Alfred Haunold, (503) 757-4424*

**A yeast that occurs naturally on citrus rinds can prevent fruit rots** that claim about 25 percent of the fruit harvested worldwide. ARS and Israeli researchers have co-patented three new strains of the yeast *Pichia guilliermondii*, which can be cultured easily in fermentation tanks. It has been found effective against several fruit rotting organisms that strike a number of fruits after they are harvested. Among the fruits: grapes, apples, pears, tomatoes, persimmons, grapefruit, oranges and lemons. Fruit treated with this yeast don't need fungicidal treatments against several fruit-rot pathogens. Yeast strains can be applied by dipping, spraying or brushing—and can be incorporated into waxes, wraps or other protective coatings. Application can be made before or after harvest. But the preferred time is after harvest and prior to storage and shipment. (PATENT 5,041,384)

*Appalachian Fruit Research, Kearneysville, WV  
Charles L. Wilson, (304) 725-3451*

**Dark crimson lettuce may give tomorrow's salads a new look.** Other options: unusual lettuces with yellow leaves, or blue leaves atop long stems eaten like celery. These surprising new colors, shapes and textures appeared in a test garden of nearly 400 kinds of lettuce planted by ARS scientists. Plant breeders can use these varieties to add unusual traits to the familiar iceberg, butterhead or loose-leaf lettuces. Seeds for the garden came from a permanent collection preserved by

the researchers. To find other promising lettuces, researchers will plant new test gardens over the next several years.

*Vegetable Production Research Unit, U.S.  
Agricultural Research Station, Salinas, CA  
Edward J. Ryder/William Waycott, (408) 755-2800*

**Soggy sandwiches or pizzas may someday become just a bad memory.** In ARS tests, a colorless film, which is potentially edible, formed a moisture barrier between filling and bread that kept the latter dry for 2 days. It could protect pie crusts, layers of filled cakes, or other foods, too. The finished film won't interfere with food flavors, scientists report. The films are made from chitosan—an extract from finely ground shells of crustaceans—and other ingredients. The compounds must be approved for food use before the film can be sold for home or commercial kitchens. Other scientists earlier proposed the idea of using the ingredients for making films. But the ARS team is apparently the first to extensively test the film's effectiveness as a water barrier.

*Process Chemistry and Engineering Research Unit,  
Western Regional Research Center, Albany, CA  
Dominic W.S. Wong/Allen G. Pittman, (510) 559-5860*

**Six new fruits from Malaysian rain forests are bound for U.S. markets** within the next few years. Plants of manga air, bruas, medang, langsat, terap, and mata kuching are now growing in greenhouses at an ARS lab in Miami. The fruits offer U.S. consumers new flavors, aromas and textures. They are the most promising of more than 85 different fruit and nut crops brought back from a plant exploration trip last year. Regardless of the fate of their native rainforests, the plant material is alive and available for research and breeding. To save time in breeding, scientists use isozyme analysis, in which protein patterns serve as genetic markers that show if plants are closely or distantly related. In addition to saving valuable breeding time, this simple procedure also allows maximum variation in germplasm collections with limited space.

*Subtropical Horticulture Research Lab, Miami, FL  
Robert J. Knight/Raymond J. Schnell, (305) 238-9321*

**A mechanized nose may one day replace the need for inspectors** to sniff dozens of grain samples daily. Grain can acquire odors from molds, bacteria, insects, and chemical sprays. These odors might be passed on to flours, cereal and bakery products. ARS scientists are trying to build an odor sensing device to replace the human nose for detecting bad-smelling grain so that it doesn't reach the consumer. Human descriptions of actual grain samples are being compared with chemical analyses of those samples. Scientists are looking for correlations that can be used to develop a data base to give the grain industry a quick, simple, objective method to assess grain odors.

*Grain Quality and Structure Research, Manhattan, KS*

*Larry M. Seitz/David B. Sauer, (913) 776-2735/2725*

**Peas that fend off common root rot, *Fusarium* root rot and pea wilt are now available** to seed companies, for crossing with their own specialized varieties. ARS scientists bred three new pea varieties that each resist all three diseases. The rots and wilt, all caused by soil-borne fungi, can't be controlled with currently registered fungicides. Common root rot has devastated pea planting in New Zealand and is a serious problem in parts of Washington, where many processing peas grow. The root rots leave pea roots brown and slimy, yielding stunted, yellow plants with few pods. The wilt causes leaves to dry and curl up. Some of the new peas' wild ancestors were collected in Ethiopia, India and Pakistan by USDA plant explorers.

*Vegetable and Forage Crops Research Unit, Prosser, WA*

*John M. Kraft, (509) 786-3454*

**Gypsy moths become their own enemy** in a new technique to keep the pest from ravaging trees. Scientists found a method that uses the moth's fat body cells as a factory to mass produce a new natural virus that's lethal to the pest. Called Abby, the virus is specific to gypsy moths and doesn't endanger other animals or plants. Moth fat cells work much like the human liver, regulating many metabolic processes in the insect. That makes the cells the perfect site for reproducing the virus in cell culture. Previous attempts to economically produce insect virus in cell culture systems had failed. When sprayed on foliage and eaten by the moth caterpillars, the virus doesn't kill the pests right away. But many die before they can reproduce. Once they die, infected caterpillars help spread the virus in the

environment to weaken succeeding moth generations. American Cynamid, Princeton, N.J., has a license on the virus. (PATENT APPLICATION 07/373,977)

*Insect Biocontrol Laboratory, Beltsville, MD*

*Edward M. Dougherty, (301) 504-6692*

## **Animal Production and Protection**

**A long-unappreciated forage crop named "birdsfoot trefoil" could provide needed protein** to dairy cows without causing them to bloat. Bloating occurs when feed such as alfalfa breaks down inside the cow's first stomach, called the rumen. That results in the internal buildup of gas, which can lead to cardiac arrest. Birdsfoot trefoil contains tannin, a natural antibloating compound that helps resist the breakdown of forage by bacteria living in the cow's rumen. Also, tannin binds with proteins in the feed; the rate of digestion slows, giving the cow more time to use the proteins for making milk or meat. Birdsfoot trefoil can also tolerate poor soil conditions and heavy grazing much better than alfalfa.

*Plant Genetics Research, Columbia, MO*

*Paul R. Beuselinck, (314) 882-6406*

**Giving dairy cows a one-a-day vitamin and mineral supplement** could help them ward off infectious diseases such as mastitis. In studies with Jersey cows, ARS scientists observed that blood levels of vitamin A, vitamin E, and zinc dropped sharply around the time cows gave birth. A deficiency of any one of these three nutrients reduces immunity to disease. Lower concentrations of zinc were seen in the blood of cows with milk fever. In current studies, researchers are evaluating the effect of short-term nutrient deficiencies in another group of cows getting supplements of vitamins A and E, and zinc prior to giving birth.

*Metabolic Diseases and Immunology Research, National Animal Disease Center, Ames, IA*

*Marcus E. Kehrli/Judith R. Stabel/Jesse P. Goff, (515) 239-8547*

**Frozen catfish sperm has been used successfully to produce offspring.** Liquid nitrogen at -80 degrees C was used to freeze sperm solution from two males that was later used to fertilize eggs from several female channel catfish. Progeny from the frozen sperm survived and appear to be growing normally compared to their siblings produced with untreated sperm from the same males. The technique of cryopreservation



may allow the catfish industry to store sperm from selected males with desirable traits, such as growth rate, and introduce these traits into other strains or produce hybrid catfish. Currently, only small quantities of sperm can be obtained from individual males, but scientists are searching for ways to improve sperm collection so that the freezing technique could be more widely used in breeding programs.

*Catfish Genetics Research, Stoneville, MS*  
Cheryl A. Goudie, (601) 686-2986

**Healthy cattle can be carriers of a bacterium that causes pneumonia in the herd.** The information obtained may lead researchers to prevent "shipping fever," a term used to describe a group of stress-related respiratory ailments that cost cattle producers about \$800 million annually. In sick cattle, the bacterium *Pasteurella haemolytica* is commonly found in the nose and lungs. ARS researchers have isolated the bacterium from the tonsils of healthy cattle. The bacterium can emerge during stress and cause pneumonia. These studies—the only ones of this type being done in the United States—will look at the relationship of tonsils to stress factors.

*Respiratory Disease Research, National Animal Disease Center, Ames, IA*  
Glynn H. Frank/Robert E. Briggs, (515) 239-8280

**A newly formulated vaccine successfully protects chickens against Marek's disease without exposing the bird to disease-causing genes.** Marek's disease is a potentially fatal cancer which afflicts young chickens. For the past 20 years they have been treated with a live-cell vaccine. Such a vaccine contains both disease-causing genes and those responsible for the immune reaction. ARS scientists used genetic engineering techniques to insert only the gene which causes the Marek's immune response into the DNA of the fowlpox virus. An extra bonus: the new vaccine also protects against fowlpox. Scientists expect the vaccine to be commercially available within two years. (PATENT APPLICATION 07/722,860)

*Avian Disease and Oncology Lab, East Lansing, MI*  
Keyvan Nazerian, (517) 337-6828

**Increasing the efficiency of cattle production will become easier once ARS scientists complete their livestock gene mapping project, now in its initial phase.** With a significant percent of the human, mice and cattle genes sharing similarities, researchers hope to make use of the existing human and mouse gene

libraries to locate evenly spaced genes along the 29 chromosomes in cattle. DNA probes will be used to seek out alternative forms of each gene. Once the genes are found, they will be cataloged. Identification of genes or groups of genes that control specific diseases, fat, tenderness, muscle development, ovulation rate, and other traits of economic importance will give researchers the tools to breed the most efficient cattle possible.

*Genetics and Breeding Research Unit, Roman L. Hruska U.S. Meat Animal Research Center, Clay Center, NE*  
Craig W. Beattie, (402) 762-4359

**Screwworm eradicators using an ARS technique recently squelched an outbreak of the most gruesome of livestock pests in Libya.** The screwworm fly lays its eggs in the wounds of warm-blooded animals and humans. The eggs hatch into larvae—screw-shaped maggots—that eat the living flesh around the wound. In December 1990, the United Nations' Food and Agriculture Organization (FAO) began dropping millions of male flies that had been sterilized by radiation. Sterile males mate with wild females; eggs are barren. The sterile insect technique was pioneered by two ARS researchers in the 1950s. Sterilized screwworms were reared by the U.S.-Mexico Screwworm Commission at USDA's Animal and Plant Health Inspection Service facility in Tuxtla Gutierrez, Mexico, and sent in airplanes to Libya. The last shipment was in October 1991. APHIS and ARS used this technique to eradicate screwworms from Curacao in 1954, the southeastern U.S. in 1959, the southwestern U.S. in 1966, and Mexico in 1990.

*Screwworm Research, Tuxtla Gutierrez, Mexico*  
Chandler J. Whitten, 011-52-961-32499

**Tiny kangaroo rats are helping to reseed Nevada's Great Basin desert with Indian ricegrass—a native plant that benefits both ranchers and the environment.** At night, the furry, little tan animals gather Indian ricegrass seeds in their fur-lined cheek pouches and then bury the seeds in shallow holes. The seed caches they neglect to recover appear to be a primary source of new ricegrass seedlings. The plants provide excellent forage for grazing cattle during the long, harsh Nevada winters. And the plant's extensive root system helps stabilize land that's been burned, mined or overgrazed. Scientists found two types of beneficial fungi in the rat's cheek pouches, which may explain why seeds the rats have carried germinate better than seeds untouched

by the rats. Continuing studies focus on how the rats recover and distribute their seed caches. Such information should help tell how well Indian ricegrass will grow when planted for forage, as well as how quickly the environment will recover from a range fire.

*Landscape Ecology of Rangelands, Reno, NV*  
William S. Longland, (702) 784-6057

## **Soil, Water and Air**

**Slow-release nitrogen fertilizer can help farmers reduce nitrate** in their spring water and drinking wells. So can reducing the application rates of conventional ammonium nitrate. A 15-year study has shown that spring water underneath pastures receiving methylene urea—the slow release fertilizer—tested at 7 to 14 parts per million (ppm) of nitrate-nitrogen. Where conventional fertilizer was applied, the underground water tested at 10 to 16 ppm. Environmental Protection Agency guidelines for drinking water allow a maximum of 10 ppm. Both fertilizers were applied at 150 pounds per acre, a rate that is high but not uncommon among farmers. When ammonium nitrate was applied at 50 pounds per acre, the water tested at only 3 to 5 ppm.

*North Appalachian Experimental Watershed Research, Coshocton, OH*  
Lloyd B. Owens, (614) 545-6349

**Crop stalks and straw left standing on fallow land after harvest defend the Great Plains against dust storms** by slowing the wind speed near the surface and by protecting the soil. Once the stems have fallen, surface wind speed is higher and crop residues decompose more rapidly, with more risk of erosion. That's why predicting when the stems will fall is so important. Researchers are counting and measuring stalks of grain sorghum and straw from wheat and other small grains over the 11-month fallow period common to the Great Plains. So far, they have found that the more crop stalks or straw, the longer it takes for them to fall. This is probably because they physically support each other. It could also be that microbial activity is slower in soils kept cooler by the insulating residue cover. Prior to making the measurements, it was expected that increased moisture under higher residue levels would increase the microbial activity that weakens the stems

at the soil surface and allows them to fall or be blown over more quickly.

*Soil and Crop Management Research, Conservation and Production Research Lab, Bushland, TX*  
Harry H. Schomberg/Jean L. Steiner, (806) 356-5738

**Chances of lead poisoning from eating vegetables grown in contaminated soil can be reduced** by adding composted sewage sludge to the soil. A study of soils from gardens in Baltimore, Md., showed that the sludge "binds" lead and prevents its absorption by plants. Lead levels in lettuce leaves were reduced by as much as 64 percent. Levels in spinach leaves declined by over 50 percent. Several of the soils studied had lead levels of 1,000 to 5,000 or more parts per million (ppm). The Environmental Protection Agency considers soil with more than 500 ppm to be hazardous waste.

*Soil-Microbial Systems Lab, Beltsville, MD*  
Rufus L. Chaney, (301) 504-8324

**Less plowing is good for the soil—and bad for a fungus** that reduces potato yields by up to 10 percent. Chemical controls are either ineffective or too costly against the fungus *Rhizoctonia solani*. But in three years of field studies, scientists found that chisel plowing—which cuts into the soil but doesn't turn it over, so there's less soil erosion—reduced the fungus infection as much as 50 percent in potatoes. That happened when each of five crops was rotated with potatoes planted after chisel plowing. Rotated crops were oats, lupin, buckwheat, broccoli and peas. The lowest fungi levels were in potatoes planted after broccoli in soil that had been chisel plowed at a depth of 12 inches. Scientists are not certain why the fungus population was lower than in more extensively plowed soils. But one possible answer: *Rhizoctonia* was forced to compete with harmless fungi that grew on the leftover stubble of broccoli and the other plants that the chisel plowing left on top of the soil.

*New England Plant, Soil and Water Lab, Orono, ME*

Simeon S. Leach, (207) 581-3266

**The amount of atrazine and alachlor herbicides leaching through nightcrawler burrows in agricultural fields** depends greatly on the timing of major rainstorms. A study of topsoil sections from long-term no-till cornfields shows that a minor storm occurring



after herbicide application immobilizes the herbicides in the topsoil where there is a lot of organic matter from crop residue that has not been plowed under. The herbicides mix and bind with the organic matter. Very little moves downward toward groundwater. But if the first storm after herbicide application is a major one, then the chemicals can be washed into and through worm burrows as deep as 3 feet. Researchers showered 1-cubic-foot topsoil sections with water to simulate rain. Atrazine losses after a 1-inch rain were double the losses when the initial rain was only 0.2 inch and also when the first rain came an hour after chemical application instead of a day later. This type of data is used to find out how chemical movement under no-till conditions can be minimized.

*North Appalachian Experimental Watershed  
Research, Coshocton, OH  
W.M. Edwards, (614) 545-6349*

## **Crop Production and Protection**

**An environmentally friendly pair of herbicides** killed just under 90 percent of unwanted mesquite trees in a Texas field test. Overgrazing and other factors have allowed the woody mesquite to infest an estimated 90 million acres of rangeland in the Southwest, soaking up scarce water and crowding out forage grasses for livestock. Prior to 1985, a chemical known as 2,4,5-T was used to control mesquite. The Environmental Protection Agency banned its manufacture and use that year, so ranchers turned to mowing the seedlings, using tractors to rip out the trees or other methods to eliminate the mesquite. But in 1989 and 1990 field tests, the herbicides, triclopyr and clopyralid, mixed in water, were sprayed on several hundred trees on a 10-acre tract on the Blackland Prairie near College Station, Tex. The result: the mixture killed 87 percent of the trees, which were from three to six feet tall. Extension Service agents now recommend that Texas farmers and ranchers use the mixture to control mesquite.

*Weed Science Lab, Beltsville, MD  
Rodney W. Bovey, (409) 260-9238*

**A coating that extends shelf life of fruits and vegetables** has been found to kill Caribbean fruit flies in grapefruits, mangoes and carambolas. Such fruits are hosts to the pest in Florida and must be treated before they can be shipped out of the state. All the ingredients in the original coating were found in laboratory

analyses to be safe for humans to eat. Different formulations of the coating are being studied to determine which works best at killing fruit flies when applied on the outside of fruits. Scientists are combining the coating with other quarantine treatments such as hot air, cold storage and methyl bromide fumigation to see which combinations are the most effective. Scientists at the ARS Winter Haven lab originally developed the coating to lengthen shelf life of produce and filed for a patent. A Florida company has received a license to use the coating as a quarantine treatment. (PATENT APPLICATION 07/679,849)

*Subtropical Horticultural Research Lab, Miami, FL  
Guy J. Hallman, (305) 254-3624*

**A new blackeye pea resists attack** from two of the most damaging pests in the southeastern states—and can bring up to 35 percent higher yields for home gardeners and commercial growers. The new variety, Bettergro Blackeye, is resistant to both the cowpea curculio that invades pea pods and to root-knot nematodes that damage plant roots. Southern gardeners and farmers selling it fresh often get a second crop after the regular harvest. Pods contain an average of 12 or 13 peas each. Yields were from 13 to 35 percent higher than competing varieties during field trials at about 16 locations in five states from 1986-89. Bettergro Blackeye was infested by 75 to 98 percent fewer cowpea curculios than susceptible varieties. And resistance to the root knot nematode will allow farmers to cut down on chemical nematicides, which are applied to soil and can seep into underground water.

*U.S. Vegetable Lab, Charleston, SC  
Philip D. Dukes, (803) 556-0840*

**A new rice variety that smells like popcorn** has been released for commercial production. Dellmont has the aromatic, popcorn scent of rice imported from the Far East, and the texture of traditional U.S. long grain rice. The grains separate after they are cooked, in contrast to most imported aromatic rices that tend to stick together. Dellmont also has several advantages over other domestically grown aromatic rices: higher yield, better milling quality, more resistance to rice blast disease and less likely to fall over in strong wind or rain. Researchers expect Dellmont to have an impact—both in domestic and export rice markets—once it is grown commercially over the next few years.

*Rice Research, Beaumont, TX  
Bill D. Webb, (409) 752-5221*

**Genetic selection has pinpointed a mutant line of soybean** that has two to four times more nodules than the average plant. ARS scientists are attempting to produce these extra nodules on a normal root system to return more nitrogen to the soil. When soil nitrates are limited, a specific strain of bacteria invades the soybean root and forms a nodule. The nodule converts gaseous nitrogen from the air into ammonium for the plant and also returns nitrogenous compounds to the soil. Increased nodulation would be good news for producers who plant corn in rotation after soybean because nitrogen fertilizer applications could be cut, also reducing the opportunity for water contamination.

*Plant Physiology and Genetics Research, Urbana, IL*

*James E. Harper, (217) 244-6670*

**A plant mulch, hairy vetch, increased tomato yields** by about 138 percent and reduced insect infestation to a minimum. Tomato plants growing in vetch plots were greener and bigger than plants in plots where plastic, paper and no mulches were used. Field tests showed that, unlike plastic, the vetch mulch adds organic matter to the soil and increases water-holding capacity. Also, the vetch adds nitrogen, reducing the amount of fertilizer needed. And, the mulch suppresses early-season weeds, eliminating the need for herbicides before planting. Since the mulch repels the Colorado potato beetle—a major pest of tomatoes during the first month after field planting—decreased amounts of pesticides are needed. ARS scientists plan to test hairy vetch on other vegetable crops.

*Vegetable Lab, Beltsville, MD*

*Aref A. Abdul-Baki, (301) 504-6729*

*Weed Science Lab, Beltsville, MD*

*John R. Teasdale, (301) 504-5504*

**All weather plants may be the payoff from the successful transfer of a gene** from a warm-season crop—cucumbers—to the cool-season tobacco plant. The ultimate goal is to custom-design cotton and other farm crops so they yield more—even in the face of drought and daily or seasonal temperature extremes. The transferred gene codes for the “warm” version of NADH hydroxypyruvate reductase, an enzyme involved in plant stress. This resulted in a tobacco plant with an equal mix of the “warm” and “cool” versions of the enzyme. According to the theory proposed by ARS scientists and confirmed by tests on enzymes in plants, the enzymes have their own individual “thermostats” that are set by their species-specific gene se-

quence. Under this theory, the thermal kinetic window, or preferred temperature range, for cucumber, is 81 to 101 degrees F, while for tobacco it is 66 to 82. Altered tobacco plants have a combined range for the activity of the composite enzymes of 66 to 101 degrees F. So in terms of temperature, the hydroxypyruvate enzyme in the offspring behave like cucumber during the heat of day and tobacco in the cool of night.

*Plant Stress and Water Conservation Research, Lubbock, TX*

*Melvin J. Oliver/John J. Burke, (806) 746-5353*

**Tiny hairs could cause big problems for insects that eat alfalfa.** Those hairs grow on the stems of an alfalfa cousin and act like a fence to block the pest larvae from reaching alfalfa leaves. Without the leaves as food, the insect will starve on the stem. The tiny hairs are only one of the potential benefits of alfalfa cousins known as annual medics. Little known in the United States, these legumes are grown on a large scale in Australia, where they provide high-protein livestock feed while replenishing nitrogen in the soil. The annual medics, like alfalfa, are in the *Medicago* genus, but annual medics need to be seeded each year, while alfalfa is a perennial. To tap the benefits of annual medics, ARS and University of Maryland researchers have developed a core collection of 210 annual medics samples for breeding. These varieties were selected for 18 agronomic traits, such as forage yield, growth habit, pod production, and flowering date. Scientists are now evaluating the collection in field trials at five locations across the United States—Beltsville, Md., St. Paul, Minn., Logan, Ut., Pullman, Wash. and Tucson, Ariz.

*Soybean and Alfalfa Research Lab, Beltsville, MD*

*Gary R. Bauchan, (301) 504-6649*

**Growing cucumbers on a trellis** rather than on the ground may cost more but the added expense can be recouped by higher yields. That's good news for commercial growers and also small farmers who are looking for alternatives to increase their income. Three varieties of cucumbers (*Cucumis sativus* L.)—Dasher II, Marketmore 76 and PetoTripleMech—were grown with and without trellises. Trellising improved marketable yields about 20 percent, compared to the on-the-ground crop. Average weight of marketable cukes was not affected. Harvesting cukes from trellises took about half the time it took to harvest them on the ground. The project, done in cooperation with Oklahoma State University, indicated that the expense



of trellises could be recovered in just two years. Trellises could be reused for at least three more years at no additional cost.

*Genetics and Production Research, Lane, OK*  
*Vincent M. Russo, (405) 889-7395*

**Corn is a lot like a woman's hair.** Some days it takes a beating from the wind, rain or damaging sun without much tending. Other days, it just doesn't hold up. When corn "doesn't hold up," it literally falls over—a condition known as lodging. Corn stalk lodging accounts for up to 25 percent of U.S. grain yield loss. ARS researchers have adapted a commercial stress gauge called a rind penetrometer to help plant breeders identify corn genotypes with superior stalk strength plus high grain yields. A digital display and stop bar on the electronic gauge makes for quick, accurate readings.

*Corn Genetics Research, Columbia, MO*  
*Larry L. Darrah, (314) 882-2349*

**Peach trees that frustrate root-attacking worms could come from tiny trees reared in lab dishes.** With a fast new lab test, ARS scientists now can rate a peach tree's ability to ward off a microscopic worm called the southern root-knot nematode. It's the second-worst nematode attacking Southeast peaches, and costs South Carolina growers about \$1.3 million a year in pesticides to protect fruit yield. Growing resistant varieties would lower the need for pesticides. The new 5-week test works as well as current ones that take up to 4 years in outdoor plots. It's the latest application for an ARS technique for growing trees from lab shoot cultures. The scientists rated nematode resistance for several commercial varieties. The top performer, Compact Redhaven, was previously unknown to tolerate nematodes. It housed few of the pests despite being challenged by heavy infestations. That should boost its appeal to consumers yearning to chomp into a peach plucked fresh from a backyard tree. But its greatest potential—which must be confirmed by further research—may be as rootstock on which fruit-producing scions are grafted.

*Nematology Lab, Beltsville, MD*  
*Robin Huettel, (301) 504-5660*  
*Plant Molecular Biology Lab, Beltsville, MD*  
*Freddi Hammerschlag, (301) 504-5286*

**Not even a jet, helicopters, a tank—or a few million pounding feet—could wear out a test plot of Zoysia**

and tall fescue grass during last June's Operation Desert Storm celebration in the nation's capital. After four to six weeks of watering and fertilizing, the four-acre site on the Washington Mall became green again. An ARS scientist developed the Zoysia-fescue mix. Originally, Zoysia's poor seed germination required that clumps of grass be planted by hand. But in the late 1970s and early 1980s, in cooperation with South Korean researchers, the scientist increased Zoysia's germination rate, so the seed could be mixed. Zoysia tolerates drought and does well in summer, while the fescue stays green in winter—for year-round color. Its survival on the Mall confirmed that the mixture grows well on compacted, dense soil. If tests continue to be successful, the grass mixture could become commercially available in two to three years. The Mall test plot was among a number of projects to evaluate grasses that may provide tougher turf, with less need for watering and chemical pesticides.

*National Turfgrass Evaluation Program, Beltsville, MD*  
*Kevin Morris, (301) 504-5125*

**Two studies in Texas—each looking at two herbicides—found the chemicals generally reached only 6 to 12 inches into the Blackland Prairie's heavy clay soils.** And at least 90 percent of two of the herbicides dissipated from the soil within 90 days of being applied, thus minimizing the risk of leaching into groundwater. In one two-year study, conducted in 1988-89, researchers disked picloram and clopyralid into the soil at rates of half a pound per acre. Clopyralid and picloram are used to control weeds and woody plants such as mesquite. Ninety days after treatment, more than 99 percent of the clopyralid and more than 92 percent of the picloram had dissipated. The herbicides were detected primarily in the upper 12 inches of soil. In the second study, begun in 1990, researchers applied atrazine and metolachlor in the springtime while planting grain sorghum. Atrazine is a leading herbicide against broadleaf weeds in corn and sorghum; metolachlor is a grass herbicide used in corn, soybeans and other crops. Soil samples taken before planting and then at specific intervals showed most of the herbicides that remained were in the top six inches of soil.

*Weed Science Lab, Beltsville, MD*  
*Rodney W. Bovey, (409) 260-9238*  
*Grassland, Soil and Water Research, Temple, TX*  
*Clarence W. Richardson, (817) 770-6500*

## **Biological Control**

**A tiny but aggressive wasp has been found that makes mince meat out of immature sweetpotato whiteflies.** ARS scientists, who discovered the wasp (*Encarsia formosa*) in Beltsville, Md., have been studying it for 2 years. As small as a fleck of dirt, the wasp is a parasitoid which, unlike a true parasite, is only parasitic in its larval stages, destroying its whitefly host as it develops. Once this adult wasp lands on a whitefly-infested leaf, she makes a beeline to a whitefly and attacks it by laying her eggs inside the pest's body. In about 15 days after the eggs are laid, new adults eat their way out of the dead whitefly's body. How efficiently the wasp attacks whiteflies depends in part on the interaction between the pest and its host plant. The scientists continue to study the wasp to discover how—visual, chemical or olfactory—it finds and homes in on its host. Once they know the mechanism, they will be better able to use wasps as biocontrols. Based on the success of this research, USDA's Animal and Plant Health Inspection Service will start mass rearing wasps at a facility in Mission, Tex. From there, wasps will be sent to at least six locations for testing. ARS, APHIS, several universities and private industry are cooperating on the project.

*Florist and Nursery Crops Lab, Beltsville, MD*  
*Jo-Ann Bentz, (301) 504-8260*

**A tiny weevil that feeds on hydrilla** has been put to work for the first time in California. ARS scientists and colleagues from state and county agencies want to see if the *Bagous affinis* weevils from India can thwart this troublesome aquatic weed. Weevils are being tested at two hydrilla-infested sites in the central part of the state. Over \$15 million has been spent to combat hydrilla in California. The weed forms dense mats that can entangle swimmers, clog boat propellers, choke irrigation canals, and interfere with hydroelectric power plants. Hydrilla showed up in Florida about 30 years ago and is now found in more than a dozen states. An ARS laboratory in Florida reared the weevils, a few generations removed from parents collected in southern India.

*Aquatic Weed Control Research Lab, Davis, CA*  
*Lars W.J. Anderson/Kristine E. Godfrey, (916) 752-6260*

*Aquatic Weed Control Research Lab, Ft. Lauderdale, FL*

*Gary R. Buckingham, (904) 372-3505*

## **Scientific Information Systems**

**Preventive herbicide treatments may become a thing of the past in the Corn Belt** when the Bioeconomic Weed Management computer model comes online in a few of years. The model so far has allowed scientists to grow corn and soybeans with fewer herbicides. It predicts when and how many weed seedlings will emerge in the spring and the expected crop yield reduction. Then it compares the costs and benefits of various options such as leaving the weeds alone, cultivating to remove weeds, or applying herbicides. Using the model's weed seedling emergence data, scientists accurately predicted the best dates for cultivating to substantially destroy various types of weeds. The model balances the day of maximum emergence with the predicted yield loss from delayed planting and comes up with a compromise date for maximum weed control and crop yield. The model is being developed by ARS scientists and an agricultural economist at the University of Minnesota, in cooperation with weed scientists in each Corn Belt state.

*Soil Management Research, Morris, MN*  
*Frank Forcella, (612) 589-3411*

**Everything you want to know about flies** is in a computer database that will eventually include more than 200,000 fly names worldwide. Some flies cause millions of dollars in damage to crops and livestock worldwide, while others are useful as pollinators, predators and parasites of man's insect enemies. So it's imperative that the name for each species be uniform and unique. Compiled from literature dating back over 200 years, the database now lists valuable information on some 2000 fly names, their distribution and classification. Current valid names are listed as well as those that have been used in other parts of the world for the same species. With this information, scientists interested in controlling flies, using them for biological controls or pollination, or lessening their impact on man, will be able to better communicate their research results. The first segment of the database is available now to all users to clear up the confusion over names.

*Systematic Entomology Lab, Washington, DC*  
*Chris Thompson, (202) 382-1800*



# Quarterly Report

of Selected Research Projects

January 1 to March 31, 1992

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Sweetpotato Whitefly: A Special Report

ARS research to control the ruinous sweetpotato whitefly increased in the late 1980's. That's when this insect, known as *Bemisia tabaci*, began emerging as a destructive pest of many U.S. food, feed and fiber crops. Now, several ARS research advances are being used in USDA and state control programs and have reached the stage of commercial research and development. What follows are summaries of that and other whitefly research.

"Sting" operations could help combat the whitefly, because ARS is collecting and testing tiny wasps that show promise in attacking the pest. Several species of parasitic wasps imported from Europe have been shipped from an ARS quarantine facility in Mississippi. ARS has supplied the wasps to universities and other research facilities to conduct field studies in states where whiteflies are damaging crops. Female parasitic wasps sting immature whiteflies and lay their eggs in the pests. When the eggs hatch, the wasp larvae feed upon the young whiteflies, which die before maturity. It will take several years for wasp populations to build up

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, Bldg. 419, BARC-East, Beltsville, MD 20705, (301) 504-9108 or 504-8916.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786.

to control the whitefly outbreak. The wasps don't sting humans. *D.D. Hardee, Southern Insect Management Laboratory, Stoneville, MS, (601) 686-2311*

Thousands of ARS-imported wasps were released by APHIS earlier this year in California's Imperial Valley and Texas' Lower Rio Grande Valley. ARS scientists based in Montpellier, France, collected these parasitic wasps, *Eretmocerus mundus*, in Greece. These scientists are the primary sources of whitefly parasites, predators and pathogens shipped to various USDA quarantine facilities in the United States. Besides the wasps from Greece, the Montpellier scientists recently shipped other natural enemies of the whitefly from Spain, India, Pakistan and Nepal. They plan other shipments this year from these countries and from Egypt, Israel and Turkey. In addition to field collections, the scientists are completing in-depth research on whitefly pathogens and parasites at Montpellier. *Lloyd Knutson, European Biological Control Laboratory, Montpellier, France, international telephone 33-67-04-56-00*

Big-eyed bugs could become the second ARS-studied insect released *en masse* against the whitefly. This native bug is a predator. In its first outdoor test last January in the Imperial Valley, big-eyed bugs ate up to 40 percent of the whiteflies held in cages placed in fields. ARS and APHIS cooperated in the test. A second test began in March. If the bugs pass muster, APHIS will be ready to rear hundreds of thousands of them for releases this summer. That's because ARS scientists developed an inexpensive diet for large-scale rearing. The diet—a mix of mainly hamburger, liver and sugar—closely matches the bug's natural diet of insects. The alternative to this diet would be far more complicated and expensive. It would require growing hundreds of plants in greenhouses to raise millions of sweetpotato whiteflies or other insects as food for young big-eyed bugs. *Allen C. Cohen, Western Cotton Research Laboratory, Phoenix, AZ, (602) 379-3524*

A predatory beetle and five parasitic wasps native to Florida could slow the whitefly's onslaught. The beetle, *Delphastus pusillus*, can devour several



hundred whitefly eggs a day and eats all stages of the pest from egg to adult. As a result of cooperative research with the University of Florida, the beetle is now being reared commercially. However, it's difficult to rear because of its appetite for whiteflies. ARS scientists plan research on an artificial diet. The wasps are *Eretmocerus californicus* and *Encarsia formosa*, *nigricephala*, *transvena* and *tabacivora*. Some show potential for commercial use. None of the insects is harmful to humans, other animals or plants. *Kim A. Hoelmer, U.S. Horticultural Research Laboratory, Orlando, FL, (407) 884-2034*

**A naturally occurring fungus protected several crops from the whitefly in ARS greenhouse and small outdoor tests in Texas.** Immature whiteflies, called nymphs, died after the fungus, *Beauveria bassiana*, spread through their bodies. The fungus killed whiteflies on cotton, cantaloupe, broccoli, bell pepper, celery, tomato, cucumber and watermelon plants. The fungus is common in soils around the world. An ARS scientist first isolated it on boll weevils—major pests of cotton. A Phoenix, AZ, company has applied for an experimental use permit from the Environmental Protection Agency for wide-scale tests of the fungus

against whiteflies and boll weevils this year. The proposed tests would total 4,000 acres of several crops in California, Texas, Arizona, Florida and Georgia. ARS and the firm, Fermone Corp., developed a fungus-and oil-based formula as a spray to kill boll weevils. The spray completely controlled them without insecticide. (PATENT APPLICATION 07/638,489) *James E. Wright, Subtropical Cotton Insect Research, Weslaco, TX, (512) 969-4876*

**ARS is aiding research efforts with another fungus with commercial potential.** This naturally occurring fungus, *Paecilomyces fumosoroseus*, was isolated and patented by the University of Florida and licensed to W.R. Grace & Company. The fungus destroys all stages of the whitefly, according to the university scientists' lab and greenhouse trials and limited field tests. ARS and university scientists are collaborating on further tests, including studies to compare the effectiveness of *P. fumosoroseus* and *Beauveria bassiana*. ARS scientists are testing *B. bassiana* on tomato and watermelon. *Kim A. Hoelmer, U.S. Horticultural Research Laboratory, Orlando, FL, (407) 884-2034*

## Background on the Whitefly

Sweetpotato whiteflies are becoming a destructive pest in California, Arizona, Florida and Texas.

Whiteflies attack some 500 crop and other plant species. Crops include alfalfa, broccoli, cabbage, carrots, cantaloupe, cauliflower, celery, citrus, cotton, cucumber, eggplant, honeydew melon, lettuce, peanuts, peppers, squash, tomatoes, watermelon, other fruits and vegetables, and poinsettias and other ornamentals. The whiteflies suck juices from plants and transmit viruses and other diseases. They also secrete honeydew, a sugary substance that nourishes mold and bacterial growth on plants. Honeydew on harvested cotton fiber gums up the machinery at ginning mills.

A single whitefly can fit on the head of a pin, but the pest makes up in numbers what it lacks in size. Hundreds may infest a single leaf. In warm weather, the insects can reproduce about every 18 days. One female can lay 80 to 300 eggs. The whiteflies are also resistant to insecticides.

Last winter, ARS led the scientific community in developing a coordinated, flexible plan of research and action against the whitefly. More than 150 scientists and other experts with USDA, universities, affected states and agribusiness organizations participated. Its ingredients will guide detailed development of cooperative research and action programs in six broad areas: (1) whitefly ecology, population dynamics and dispersal; (2) fundamental research (behavior, biochemistry, biotypes, morphology, physiology, systematics, virus diseases and virus vector interactions); (3) chemical control, biorationals (such as compounds extracted from plants) and pesticide application technology; (4) biological control agents such as parasitic and predatory insects; (5) crop management systems and host plant resistance; and (6) integrated techniques, approaches and philosophies. *Robert Faust, National Program Staff, Beltsville, MD (301) 504-6918*





complicated and use non-domestic oils, and non-enzyme processes don't yield as good of a product.

*Food Feed and Processing Research Unit, Southern Regional Research Center, New Orleans, LA  
George Abraham, (504) 286-4339*

**Foam insulation for the housing industry** is a likely new market for surplus cornstarch. ARS scientists have successfully used various formulations of canary dextrin, a type of cornstarch, as a filler in rigid polyurethane foam. These formulations were similar to or surpassed foams without cornstarch in qualities such as stability under different temperatures and insulation ability. The dextrin-filled foam was able to withstand more pressure than foams made with other types of cornstarch.

*Food Physical Chemistry Research, Peoria, IL  
R. Leo Cunningham, (309) 685-4011*

**Toxins produced by two yeasts** attack and block the growth of certain species of fungi, such as other yeasts that cause mastitis in cows or spoilage in fermented food and beverages. ARS researchers isolated toxic proteins from strains of the yeasts *Pichia inositovora* and *P. acaciae*. The antifungal activity of the toxins could be of potential use in the agricultural, pharmaceutical and food and beverage industries. Genes carried on linear plasmids—short, double-stranded pieces of DNA—are thought to be responsible for the toxin production. (PATENT APPLICATION 07/733,512)

*Microbial Properties Research, National Center for Agricultural Utilization Research, Peoria, IL  
G. Thomas Hayman, (309) 685-4011*

**Scientists are looking for new defensive compounds** to help crops fight off fungal diseases and insects. ARS and Michigan State University scientists have taken the first step by genetically engineering a tobacco plant to produce a compound that is related to some natural plant defense compounds. Scientists isolated, cloned and inserted a gene from a fungus (*Fusarium sporotrichioides*) into a tobacco plant. The transformed plant made the fungal enzyme, called trichodiene synthase and produced small amounts of the enzyme product, trichodiene. If genetically engineered into other crops, enzymes that produce fungal toxins could reduce the amount of chemical fungicides and insecticides now released in the environment.

*Mycotoxin Research, Peoria, IL  
Thomas M. Hohn, (309) 685-4011*

**A hot-water bath may soon open new domestic and export markets** for Florida guavas. Because the fruit is a major host of the Caribbean fruit fly, it cannot be shipped from Florida to other states or countries that don't have the pest. But ARS scientists have developed a hot water immersion treatment that kills the fly without damaging the fruit. In research trials, the method exceeds the required mortality rate for the fruit fly. Scientists are submitting the hot water quarantine method to state regulatory officials for approval. Currently, no pesticides are approved for use against this pest on guavas, nor is there an approved quarantine treatment.

*Subtropical Horticulture Research Lab, Miami, FL  
Walter P. Gould, (305) 238-9321*

**A shot of calcium means fewer rotten apples** in the storehouse. With a pressure infiltration method, ARS scientists injected additional calcium into fruit after harvest. That reduced gray mold rot and bitter rot in apples by more than 50 percent. The fruit's level of maturity is the most important factor in determining how well this method will work, scientists say. Picked too soon, apples won't allow enough calcium to enter; picked too mature, they can be injured by letting in too much calcium. ARS and University of Tennessee researchers and a major packing facility are running a pilot test to determine the method's commercial feasibility.

*Horticultural Crops Quality Lab, Beltsville, MD  
William S. Conway, (301) 504-6128*

**A new catching device to keep free-falling apples and other fruit from being damaged** during harvest has been patented by an ARS scientist. This device could be attached to mechanical harvesters, making it feasible to harvest fresh-market fruits by machine. The catcher includes several pairs of rotating rollers positioned above a conveyor belt on a mechanical harvester. The foam rollers slow the speed of fruit as it falls from the branch, preventing one piece of fruit from damaging another as it lands on the conveyor belt. The catcher was designed for a mechanical harvester developed by ARS scientists several years ago, but can be used with any harvester that shakes fruit off the branch and catches it. (PATENT 4,999,986)

*Appalachian Fruit Res. Station, Kearneysville, WV  
Donald L. Peterson, (304) 725-3451*



**Reducing the number of blemished apples and cherries going to market** may be as simple as shedding more light on inspection. ARS and Michigan Agricultural Experiment Station researchers found that the fluorescent lights used in the sorting areas of fruit packing plants often provide only one-fifth to one-third of the light needed for detecting external marks and bruises on the fruit. White light with a Color Rendering Index (Ra) of 70 or greater is recommended for manual sorting. Natural light at midday is considered to have a Color Rendering Index of 100. The researchers also said a dark background works best for sorting and inspecting fruit because there's no glare to interfere with inspectors' view; currently, most packing lines use white conveyor belts and light-colored side rails.

*Fruit and Vegetable Harvesting Research, East Lansing, MI*  
*Galen K. Brown, (517) 353-5185*

**Analyzing soybeans for fatty acid content** can be reduced from hours to minutes using new ARS technology being developed in partnership with an Iowa company. Fatty acid content is important because at least one of the acids, linolenic acid, can lead to off-odors when the soybean oil is cooked. In the new system, a beam of near-infrared light is passed through each seed. The amount of light absorbed by the seed is noted by a computer, which generates information about fatty acid content of that seed. When fully developed, the new method can screen a seed in 2 minutes, compared with 6 hours for the current method. Also, this process will save valuable seeds that are destroyed during current analysis methods. Scientists at ARS' National Center for Agricultural Utilization Research analyze nearly 20,000 seed samples each year for public breeders in the United States. Working under a cooperative research and development agreement with ARS researchers, MBS Inc., a technology transfer company in Ames, IA, plans to market the technology to private soybean breeders.

*Analytical Chemistry Support Unit, Peoria, IL*  
*James F. Cavins, (309) 685-4011*

**Backyard gardeners** in the eastern United States could be planting miniature iceberg lettuce by 1993. The new, soft-ball size "Mini-green" lettuce, developed by ARS, might appeal to small families and single

people. Regular-size iceberg lettuce is difficult to grow in the East. Typically, warm weather prevents heads from forming and makes lettuce "bolt"—a sudden surge of growth that causes a flowering stalk to protrude through the head. Bolted lettuce is tough and bitter, making it unmarketable. But the new midget lettuce didn't bolt in small-scale ARS tests in New York and Pennsylvania. Tests planned for this year on the East Coast will determine if the lettuce maintains the sweet taste consumers expect. Scientists expect seed packets of Mini-green to be on the market by next year.

*U.S. Agricultural Research Station, Salinas, CA*  
*William Waycott, (408) 755-2800*

**Kenaf, an emerging alternative crop** in the United States, has many diverse uses—but which variety is best for a given use? Now, from results of a 2-year study of five kenaf varieties, ARS scientists have identified plants best suited to a given use. The crop was planted in May and harvested in October. Plant parts (stalk, leaf, bark, and core) were measured and weighed. Tainung #2 grew the tallest; its stalk diameter and higher percentage of core material make it excellent as poultry litter or as a substitute for wood chips for composting sewage sludge. Everglades 41 and Everglades 71 had a greater percentage of stalks—ideal sources of pulp for making paper. Guatamala 51, with greater leaf yields, is best suited as a high-protein livestock feed. Cuba 108's greater percentage of bark and its bark-to-core ratio make it well suited for specialty pulp or for making cordage (twine, rope and sack cloth).

*Genetics and Production Research, Lane, OK*  
*Charles L. Webber III, (405) 889-7395*

**Genetic editing may garner government approval more quickly** for tomorrow's gene-engineered food crops. ARS scientists have refined a technique to edit "marker genes" out of the crops. In the lab, scientists typically link one marker gene to each new, useful gene, such as a gene that improves flavor or insect resistance. The marker makes it possible to find the rare cells that accept the new gene. After that, however, the marker isn't needed. Now that researchers can delete the marker, federal regulators would have fewer new genes to scrutinize in their reviews to ensure that a new gene-engineered tomato or other food is safe

to eat. The scientists used an enzyme from a natural microorganism to do the genetic snipping. They chose tobacco, a common laboratory model, for their experiment, but they say the technique should work with dozens of other crops. (PATENT APPLICATION 07/725,320)

*Plant Gene Expression Center, Albany, CA  
David W. Owl/Emily C. Dale, (510) 559-5900*

**Oatrim, a high-soluble-fiber modified oat flour** designed by an ARS scientist to replace fat in foods, is now being produced by Conagra. Used as a powder or mixed with liquid to form a gel, oatrim can replace a major portion of shortening in breads, cookies, cakes and other foods. Conagra, one of three companies that obtained a license to make the patented flour, has been adding oatrim to extra-lean ground beef since last fall. In addition, the other two licensees, Quaker Oats Co. and Rhone-Poulenc Inc., have announced plans to make and sell oatrim. Oatrim is commercially available to food companies for use in meats, baked goods, bakery mixes, icings and fillings, extruded cereals and confections. (PATENTS 07/373, 978; 07/622,590)

*Biopolymer Research, Peoria, IL  
George E. Inglett, (309) 685-4011*

**Sunkist has commercialized an ARS process** that easily separates the peel from oranges and grapefruit without marring the fruit or losing any juice or vitamins. ARS researchers developed and patented the easy-peel process that uses a mixture of pectinase and water to soften the pithy white albedo that binds the peel to the fruit. Peeled and chilled oranges and grapefruit have a shelf life of about 21 days. The technique allows fruit to be dispensed in individual, sealed plastic containers in vending machines in places such as health clubs and schools. (PATENT 4,284,651)

*Citrus and Subtropical Products Laboratory, Winter Haven, FL  
Robert A. Baker, (813) 293-4133*

## Scientific Information Systems

**Computer-simulated duststorms** could soon help farmers and public officials prepare for real duststorms and reduce the threat to crops, air quality and even highway safety. ARS scientists have developed mathematical models, suitable for computers, that describe in a new way how soils behave in a windstorm. Scientists compiled data from field studies undertaken in duststorms. That led to new findings on the dynamics of windblown soils at various heights above the ground and the characteristics of soil surfaces vulnerable to wind erosion. Conservationists and farmers could use computer programs of the models to combat wind erosion and crop injury. Environmental and public health officials could anticipate and deal with air pollution caused by dust. And highway and conservation offices could lower the odds of the kind of sudden, blinding duststorm in 1991 that caused a disastrous pileup on California's major north-south freeway in the San Joaquin Valley, which cuts through the state's biggest agricultural area.

*Cropping Systems Research Unit, Big Spring, TX  
Donald W. Fryrear, (915) 263-0293*

**Soil fertility patterns can be analyzed from videos** shot from airplanes if vegetation covers less than half the soil area such as between growing seasons. This finding increases the potential of airborne videos to provide timely data on large land areas for farmers, ranchers, conservationists, consultants, soil mappers and others. Scientists conducted tests over barren and partially vegetated fields in southern Alabama. A 3-camera system used filters to separately record ground images with yellow-green, red and near-infrared wavelengths. Scientists digitized the images for mathematical analysis and found that composites of the red and near-infrared wavelengths eliminated the effect of green vegetation. As a result, the video system revealed distinct patterns of the soil's color and organic content—important guides to crop and soil management. ARS conducted the research in cooperation with the University of Indiana.

*Remote Sensing Research, Weslaco, TX  
David E. Escobar, (512) 968-4824*



## Soil, Water and Air

**Fiber optics are giving scientists a new below-ground look** at how stress disrupts the nitrogen-fixing process in soybeans, alfalfa and other legumes. A probe invented by an ARS scientist and Canadian collaborator David Layzell allows scientists to make field identification of legumes that have a superior nitrogen-fixing ability in the presence of drought and other stresses, such as cattle grazing. The optical fibers on the first portable field tester of its kind have revealed what recent lab findings by ARS scientists and others have suggested: Stress causes a reduction of nitrogen fixation by restricting the ability of root nodules to admit oxygen. The concentration of oxygen in the nodule is calculated from the ratio of red to infrared light returning after passing through the nodule. In less than five minutes, breeders using this instrument—now in commercial development—could tell whether a particular plant is unusually good at maintaining its nitrogen supply under stress.

(PATENT 5,096,294)

*Appalachian Soil & Water Conservation Research,  
Beckley, WV*

*R. Ford Denison, (304) 930-5230*

**Salt buildup in agricultural soils** can now be tracked using satellites in the U.S. military's Global Positioning System. Salinity is the greatest threat to irrigated farmland in the United States and around the world. ARS soil scientists are using GPS—which helped the military in Desert Storm last year to locate allied and enemy troops—to pinpoint California sites sampled earlier for salt measurements. Scientists can return to within 50 feet of the same site to monitor salt changes and assess efforts to reduce salinity. Physical marking of the sites is generally impractical, because flags or other markers would get in the way of farm equipment or be hidden by growing crop plants. GPS and mobile salinity-measuring devices let researchers collect samples faster and more accurately—at a fraction of the cost of previous methods.

*U.S. Salinity Laboratory, Riverside, CA*

*James D. Rhoades, (714) 369-4814*

**Dead crops left on wind-swept fields** can be a herbicide-free way to protect soil from blowing away during winter months. Normally, farmers plant winter-hardy cover crops to hold soil in place, but these usually have to be killed with herbicide in the spring. So scientists

are testing whether spring and summer crops planted in late summer or fall—so that they are killed by frost—can serve the same purpose. They've found that dead cover crops provide as much soil- and moisture-saving mulch as live ones. When established in early September, by January all the dead crops provided at least the 60-percent ground cover needed to eliminate wind erosion. Forage sorghum is one of the most promising of 16 crops being tested. Another advantage: Dead plants don't use water and that means more soil moisture in the spring than if winter-hardy crops had been planted. The technique is being developed in the Texas High Plains, but it can be useful wherever wind erosion and drought are problems.

*Conservation and Production Systems Research, Big Spring, TX*

*James D. Bilbro, Jr., (915) 263-0293*

**A pinch of powder reduced soil erosion** to near zero on irrigated test plots. When added to irrigation water, the white powder—known as polyacrylamide—prevents water from washing soil particles down furrows, according to ARS researchers. The polyacrylamide molecules have an electrical charge that binds them to soil particles. This bridging of soil particles apparently helps the soil resist the force of moving water. More than 23 millions acres of corn, beans, barley and other crops are watered by furrows in the United States. Worldwide, over 2 billion tons of topsoil wash off irrigated crop lands each year, threatening their future productivity. ARS researchers found that just 10 parts per million (equal to less than a pinch per 10 gallons of irrigation water) of polyacrylamide nearly eliminated erosion for furrows in a 2-acre plot of dry beans. The treatment also enabled the water to move to plant roots more efficiently. Polyacrylamide is nontoxic and slowly degrades to water, carbon dioxide and ammonia. Researchers plan at least 2 or 3 years of additional tests to assess long-term effects on soils.

*Soil and Water Management Research Unit,  
Kimberly, ID*

*Rick D. Lentz, (208) 423-6531*

**Natural rock phosphate** looks like an economical and environmentally sound alternative to processed phosphorus for pasture production on acid soils. Greenhouse tests have shown that rock phosphate improves acid soil conditions. This allows enhanced plant root growth of soft red winter wheat seedlings. Commer-



cial phosphorus is more expensive because the raw rock has to be processed into a soluble form that roots can take in. But when the raw rock is applied to highly acid soils such as those in the Appalachian Mountains, the acidity causes the rock to dissolve. Dissolution of the rock phosphate slightly raises soil pH and increases the availability of calcium to roots while decreasing toxicity of aluminum. The result is better root growth and improved water and nutrient use. Field tests are being conducted to determine the long-term effect of rock phosphate application on soil properties and the growth of grasses and legumes.

*Appalachian Soil and Water Conservation Lab,  
Beckley, WV*

*V.C. Baligar, (304) 252-6426*

*Environmental Chemistry Lab, Beltsville, MD*

*Robert J. Wright, (301) 504-6511*

Alaskan farmers who leave barley straw and chaff residues on their fields may need to add nitrogen so future crops grow better. In Alaska's cool climate, these crop residues—which contain nitrogen—retard wind erosion when left on the soil surface but break down far more slowly than residues plowed into the soil. In the first year after harvest, ARS scientists found little difference in available nitrogen between fields with buried or surface straw. But by the second year, there was less available nitrogen in soil from fields with surface straw than from those with plowed-in residue. The researchers advise farmers who leave residue on the surface to add an extra 15 lbs of nitrogen per acre each year thereafter.

*Subarctic Agricultural Research, Fairbanks, AK  
Verlan L. Cochran, (907) 474-7652*

### **Crop Production and Protection**

Dead Kentucky bluegrass could be the key to a more natural, environmentally friendly herbicide. That's because the killed grass exudes natural compounds that can hinder other plant growth. Researchers say these compounds kill dandelions and other broadleaf weeds, and might be reproduced artificially for weed control. The compounds are similar to those seeping from dead quackgrass; at least one of the quackgrass compounds will kill slugs. The bluegrass compounds were discovered after farmers in a New York pasture renovation project had trouble getting a forage legume called

birdsfoot trefoil to grow on patches of killed grass later identified as Kentucky bluegrass.

*Plant Protection Research, Ithaca, NY*

*Roger D. Hagin, (607) 255-1712*

**Conservation tillage—reduced plowing of fields—**helps build up populations of soil microorganisms that thrive on the decaying stubble of past crops. But those same microorganisms also can use valuable nitrogen fertilizer before crop roots can. Studies have uncovered a solution: nitrogen fertilizer placed in a narrow band between crop rows, rather than spreading it evenly over the entire field. The concentrated bands of fertilizer are more than microbes in the narrow band can consume, so more is left for plant roots. Researchers also found that placing fertilizer three or four inches below the soil's surface boosts nitrogen uptake by plants, since that's deeper than microbes can thrive.

*Grazinglands Research, El Reno, OK*

*Srinivas C. Rao, (405) 262-5291*

**Annual wormwood, the source of an experimental malaria-fighting drug,** could give farmers a potential new cash crop if they can control weeds that get in the way. Annual wormwood produces a substance known as artemisinin that is used to make the anti-malaria drug. One obstacle to large-scale production of annual wormwood was that the plant is often considered a weed. So herbicides were needed that would kill competing weeds without harming wormwood plants. ARS scientists have found that the best herbicide combination is chloraben applied before seedling plants are set out followed by treatments of acifluorfen and fluazifop broadcast over-the-top. This treatment effectively controls unwanted weeds without reducing artemisinin production.

*Weed Biology and Management Research,  
Stoneville, MS*

*Charles T. Bryson, (601) 686-2259*

**Pruning tree roots in the spring** can reduce the incidence of nectarine pox to an economically acceptable level. Identified by recent research as a nutritional disorder, nectarine pox is a disease that can cost nectarine growers up to 60 percent of their crop. Although the disease—which causes unsightly warty outgrowths on the fruit's smooth skin—has been around for some time, until now no one has identified the cause. Working with the West Virginia University



Experiment Station, ARS scientists found the incidence of nectarine pox much greater when rainfall was abundant and growing conditions were right for excessive shoot growth. They found affected fruit are high in nitrogen and potassium and low in calcium, as is often the case with vigorous shoot growth. Results from the 6-year West Virginia study show that root pruning can reduce shoot growth, lower fruit nitrogen and potassium and increase calcium.

*Appalachian Fruit Res. Station, Kearneysville, WV*  
Stephen S. Miller, (304) 725-3451

**More soybean oils could be out of the laboratory and into the frying pan if they're low in linolenic acid,** a substance in the oils that develops a fishy flavor and odor during frying. Iowa State University plant breeders soaked soybean seeds in a chemical that lowers linolenic acid content. They then crossed these seeds with high-yielding soybean varieties. ARS researchers processed the resultant soybeans to produce oils with linolenic acid levels of 1.7, 1.9 and 3.5 percent. In taste comparisons, foods fried in these oils got higher marks for flavor and stability than foods fried in oils from a standard soybean variety with 6.5 percent linolenic acid. No fishy flavors were noted in potatoes fried in the modified oils. The low-linolenic-acid soybean varieties developed by ISU have been licensed to Pioneer Hi-Bred International, Inc. in Des Moines, IA, to commercialize for food and industrial uses.

*Food Quality and Safety Research, Peoria, IL*  
Timothy L. Mounts/Kathleen Warner, (309) 685-4011

**To guard against the fungus that makes aflatoxin,** seed companies have begun working with a new strain of corn from ARS scientists. The toxin is a suspected carcinogen produced naturally by a fungus, *Aspergillus flavus*. In field trials by ARS scientists, the new corn breeding line warded off fungus infections far more severe than what commercially grown corn experiences. Resistant commercial varieties are 5 or more years away. Currently, federal rules specify that raw grain or finished products cannot be sold for human consumption or animal feed if they contain 20 parts per billion or more of aflatoxin. So when aflatoxin outbreaks occur, millions of dollars in corn is destroyed to protect human and animal health. The new corn line, called Mp420, resulted from 10 generations of inbreeding and selection from a cross of two varieties, Yellow

Mosby and Hill Yellow Dent. In experiments with many test lines of corn, the scientists inoculated corn ears with the fungus. With Mp420, the fungus infected only 9 percent of kernels, compared to 31 percent on nonresistant plants. Mp420 and a 1989 release called Mp313E are the only *A. flavus*-resistant lines of corn. ARS and the Mississippi Agricultural and Forestry Experiment Station released both. Other lines are undergoing tests.

*Corn Host Plant Resistance Res., Starkville, MS*  
Gene E. Scott/Natale Zummo, (601) 325-2736

**At least 347 rice varieties in the USDA-ARS World Rice Germplasm Collection have now been pinpointed in field tests as having natural ability to repel duck-salad,** the most troublesome aquatic weed in water-seeded rice. Researchers say the germplasm collection may contain as many as 500 rice varieties that can fend off duck-salad. Also, 132 rice varieties have been identified that can repel the aquatic weed redstem, six have been found that repel broadleaf signalgrass, and germplasm from Bangladesh and India look promising against rice flatsedge and barnyardgrass. The weed-fighting rice varieties come from 30 different countries, and differ greatly in physical characteristics such as plant height and grain type. That indicates the weed-repelling ability is not genetically linked to specific physical characteristics, so transferring the weed resistance through breeding into an assortment of commercial rice varieties could be easier.

*Rice Production and Weed Control Research, Stuttgart, AR*  
Robert H. Dilday, (501) 673-2661

**At least 50 rice varieties in the USDA-ARS World Rice Germplasm Collection can tolerate a salty setting,** ARS and University of Arkansas researchers have found. Salt-tolerant rice varieties could become increasingly important as farmers pump water from underground supplies to flood rice fields. Over time, pumping may lead to a salt buildup: salts in the underground water are pumped to the surface and can leave entire fields unsuitable for most of the rice varieties now grown in the United States. The researchers have evaluated 11,000 of the 16,000 rice samples in the germplasm collection for potential salt tolerance. The salt-tolerant varieties hail from many locations around the world and represent diverse plant types, indicating that salt tolerance isn't tied to a particular type of rice plant. This should make it easier to breed



salt tolerance into assorted rice varieties that have specific traits matching market demands.

*Rice Production and Weed Control Research,  
Stuttgart, AR*

*Robert H. Dilday, (501) 673-2661*

A "smart" beehive keeps electronic surveillance of the honey bees' comings and goings. This new research tool is giving ARS scientists new insights about the ways bees work to pollinate crops and make honey. ARS scientists mounted a hive on an electronic scale that weighs the hive and its thousands of bees—to within 0.035 ounce. A computer records the weight every 15 minutes, allowing the number of bees to be automatically totalled. As few as 8 bees can be detected leaving or entering a hive. Researchers have learned that foraging bees take only an hour to a day to recruit other bees for visits to better pollen and nectar sources. Scientists previously thought this shift in work force took 2 to 3 days.

*Carl Hayden Bee Research Center, Tucson, AZ  
Stephen L. Buchmann, (602) 670-6380*

When a leaf gets old, it loses its appetite. Now, using a sort of molecular time machine, ARS scientists have shown that a damaging form of oxygen accumulates during aging and starts breaking up a key protein in the leaf. The finding explains much of a long-standing scientific mystery over how a leaf turns off photosynthesis, its sun-powered food-making machinery. In the lab, scientists introduced excess copper ions into wheat, duckweed and algae. This vastly sped up the plants' aging. It became a matter of hours instead of weeks. The simulated aging process released a flood of damaging oxygen, known as free radicals. The radicals caused the breakup of the protein known as rubisco. Its main job is to convert carbon—from atmospheric carbon dioxide—into food. The research could lead to crop plants with altered genes to either block or accelerate aging. With crops that produce large fruits, such as melons, keeping photosynthesis working overtime could yield more nutritious foods. With other crops, such as peas, shutting down early could mean a quicker harvest.

*Plant Molecular Biology Lab, Beltsville, MD  
Autar Mattoo, (301) 504-5103*

*University of Maryland, College Park, MD  
Roshni Mehta, (301) 504-5633*

Discovery of a type of mutant corn has led scientists to challenge a century-old hypothesis of how plants

grow. It has long been believed that plants need an amino acid called tryptophan in order to produce a hormone called IAA, necessary for growth processes like root formation, flowering and fruit set. IAA also affects post-harvest ripening. The newly discovered mutant corn can't make tryptophan, but it produces 50 times more IAA than a normal plant. This shows that tryptophan is not required for IAA production. The new knowledge could help scientists develop new growth regulators to improve the quality of food crops. Additional experiments are planned to identify specific steps in plants' production of IAA without tryptophan.

*Field Crops Research, Ames, IA*

*Allen D. Wright, (515) 294-8395*

*Horticultural Crops Quality Lab, Beltsville, MD*

*Jerry D. Cohen, (301) 504-5632*

Corn earworms were reduced 50 to 75 percent during a three-year study by releasing partially sterile males to mate with wild females in a pest control technique pioneered by ARS scientists. Corn earworm males were released in isolated mountain valleys in North Carolina in the 1988-90 ARS pilot study after they had been exposed to radiation in the laboratory. The radiation wasn't generally harmful to the lab-raised earworms, but did damage their reproductive chromosomes. When the irradiated males mated with wild females, the offspring inherited the damaged chromosomes—making them unable to reproduce. A similar technique was originally developed to eradicate the screwworm and has successfully controlled fruit flies. Semi-sterilized males, combined with other control measures, could be used on a large scale to combat the corn earworm, which causes an estimated \$1.2 billion in damage to corn, cotton and other crops in the United States.

*Insect Biology/Management Systems Research,  
Tifton, GA*

*James Carpenter, (912) 387-2348*

Corn rootworms aren't turned into wimps when they are reared in a laboratory. That finding is good news for scientists seeking potential new controls of this pest of corn. Corn rootworms reared in a pampered lab environment were thought to fall short of being representative of how insects in the field respond to pesticides. Now, ARS tests verify that lab-reared corn rootworms are just as healthy and vigorous as their wild brothers and sisters. Also, researchers can now collect eggs in the lab during winter and stockpile



them for spring. Previously, researchers had to gather rootworm eggs from fields for spring-time studies. Some years they couldn't collect enough.

*Rangeland Insects Lab, Bozeman, MT*  
*James R. Fisher, (406) 994-6400*

**Six new breeding lines of soft red winter wheat** may offer Southeastern farmers relief from crop losses to leaf and stem rust fungi. Leaf and stem rust fungi cost U.S. wheat farmers about \$300 million in crop losses last year. Soft red winter wheat is used for making cakes, pastries and cookies. The new lines contain genes for resistance to multiple strains of the fungi, including leaf rust resistance genes that reportedly do not exist in any currently planted commercial varieties. Developed by ARS and University of Georgia scientists, the lines were released to public and commercial plant breeders in 1991. The scientists crossed South American wheats with cultivars adapted to the Southeast, and exposed seven generations of the crossbred offspring to strains of rust found in recent annual cereal rust epidemiological surveys.

*Cereal Rust Laboratory, St. Paul, MN*  
*David L. Long, (612) 625-1284*  
*Field Introduction Research, Griffin, GA*  
*John J. Roberts, (404) 228-7335*

**Winter wheat yields increase 1-1/2 to 3 fold** when phosphorus fertilizer is added to soils lacking this key element. Scientists found that a one-time application benefits wheat crops for up to 17 years on the Great Plains, where more than half the wheat fields lack adequate phosphorus. Historically, growers have been reluctant to apply phosphorus because it can cost 3 times as much as nitrogen. Also, phosphorus was thought to disappear before plants used it. ARS studies confirmed that phosphorus pays for itself over the long-run and stays in the root zone until needed by plants. Winter wheat growers who want to eliminate long-term phosphorus deficiency can spread a high rate in granular form over the soil surface. A high-rate, surface application can be just as effective as incorporating phosphorus into soil and costs less. Also, by not tilling, residue from the previous crop is left untouched, thereby protecting soil from wind and water erosion.

*Central Great Plains Research Station, Akron, CO*  
*Ardell D. Halvorson, (303) 345-2259*

**Cotton growers who irrigate could earn an extra \$200 per acre** on fields watered with sprinklers or drip systems. Drip or sprinkler irrigation makes it possible to apply precise water volumes, in contrast to the conventional way of pumping water into cotton furrows. The key, according to ARS tests, is to irrigate 4 times in July rather than twice—the current practice for furrow irrigation. An ARS scientist discovered that sprinkler-irrigated plants grown in Arizona produced 25 percent more cotton if the plants didn't suffer drought stress during July—a critical growth period. An average of only 3 percent more water was used in the two-year study. Growers now using furrow irrigation would need to figure yields and operating costs to see if the investment in switching systems would pay.

*Western Cotton Research Lab, Phoenix, AZ*  
*John W. Radin, (602) 379-3524*

**Sprouting seeds at high greenhouse temperatures** gives a fast test for a plant's ability to withstand drought. Such a test could be important should global warming and drought endanger crops in the future. ARS researchers tested 200 strains of peanuts in a three-year study. Over that time, the findings from field-grown peanuts validated the quick greenhouse tests of seeds for drought tolerance. Scientists first identified high-temperature germinating strains. Next, the seedlings were measured for the most root growth—compared to the weight of the seed—after the tiny roots and shoots were stripped off. Then 10 strains were put to the test in greenhouses and field plots for 3 years. Almost without exception, the most drought resistant strains were those with high ratios of root growth to seed weight.

*Climate Stress Lab, Beltsville, MD*  
*Robert K. Howell, (301) 504-5133*

**A double-barrel attack of herbicide and a biocontrol rust fungus** cut yellow nutsedge weeds by up to 45 percent in infested tomato plots. Tomato plants took up nutrients and water that otherwise would have gone to the weeds—increasing tomato yields 15 percent in the field test. The weed—one of the world's most troublesome perennials—is difficult to control using herbicides alone. A herbicide, Pebulate, used with a *Puccinia canaliculata* rust found in Salisbury, MD, achieved a much higher rate of control than possible using the herbicide or rust alone.

*Foreign Disease-Weed Science Lab, Frederick, MD*  
*J. Ray Frank, (301) 619-7132*



A mysterious ailment that slowly kills apple trees has been traced to a mycoplasma-like organism, or MLO. Mycoplasmas are minute, disease-causing organisms without cell walls. The apple decline mycoplasma causes leaves to curl inward and branches to stop growing. An infected tree starts to die within 1 or 2 years. ARS scientists confirmed the diagnosis of an MLO in apple orchards in Washington State, where thousands of trees show signs of infection. Currently, the antibiotic tetracycline can be injected into trees to knock out the infection, so trees recover. But, researchers are working to find ways to prevent MLO infections. One approach: use a piece of the MLO's genetic material as a potential test for seeing if the organism is harbored by insects or other plants. These MLO transmitters then could be eliminated from the orchard to stop the disease from spreading.

*Production, Harvesting and Handling of Tree Fruits Research, Wenatchee, WA  
C. Lee Parish, (509) 664-2280*

### **Animal Production and Protection**

Dairy cows can be protected from milk fever by a simple dietary change studied by ARS scientists. Milk fever is a metabolic disorder caused by a drop in blood calcium at calving time. Current treatment with calcium injections is costly. In addition, the treatment can result in secondary effects, such as mastitis and poor reproductive performance, that cost dairy producers \$150 million a year. Researchers found that in a group of 24 cows fed a diet high in sulfur and chloride only one developed milk fever. Sulfur and chloride cause the blood pH to drop, thus stimulating the bone to release calcium and the kidney to produce the hormonal form of vitamin D.

*Metabolic Diseases and Immunology Research,  
National Animal Disease Center, Ames, IA  
Jesse Goff/Ron Horst, (515) 239-8547*

A quick, yet highly accurate method to detect a type of bovine herpesvirus may help diagnose the infection in cattle. Bovine herpesvirus 4, or bovine cytomegalovirus, causes infertility and abortion. Current tests require up to 3 weeks for results. A faster test would enable ranchers to act sooner to prevent further infection within their herds. ARS scientists produced two specially designed probes for the test. One probe detects antibodies that cows produce in response to

infection. The other, made from a fragment of the virus' genetic material, identifies the actual presence of the virus. Because the technique is so sensitive, scientists may be able to find the virus in samples of tears or semen, as well as blood, from the animals.

*Animal Diseases Research Unit, Pullman, WA  
David T. Shen, (509) 335-6002*

A high-tech DNA screening test developed by an ARS veterinarian and his research team is helping eliminate an expensive genetic disorder of Holstein cattle. Bovine leukocyte adhesion deficiency (BLAD) is an immune system disorder that costs animal breeders about \$10 million annually. The new test helps pinpoint animals carrying the recessive gene for BLAD, as well as identifying those free of the gene. When cattle with BLAD mate, one in four of their offspring will inherit the condition and will probably die within a year. The test has been used by the National Association of Animal Breeders to test bulls owned by members. ARS is currently testing 2,000 bulls and cows for the Holstein-Friesian Association of America, under the terms of a cooperative agreement. A Canadian company, Bovine Blood Typing Laboratory, has licensed the test and several U.S. firms have also applied for licenses. (PATENT 07/764,466)

*National Animal Disease Center, Ames, IA  
Marcus E. Kehrl/Dale E. Shuster (515) 239-8462*

Cows make a chemical cousin of vitamin D that may help relieve certain human diseases. ARS researchers have been studying vitamin D and its role in preventing costly cattle diseases like milk fever and mastitis. Now the scientists have identified and isolated from cow's blood a hormone that cows produce from vitamin D. The hormone is called 1alpha,24-dihydroxy ergocalciferol. Its chemical structure is similar to compounds—some related to vitamin D—being used in experimental treatment of human disorders such as osteoporosis, psoriasis and kidney disease. A Madison, WI, pharmaceutical firm has applied for a license to use the new compound as a possible preventative for these diseases. (PATENT APPLICATION 07/637,867)

*National Animal Disease Center, Ames, IA  
Ronald L. Horst, (515) 239-8312*

Calves, like their young human counterparts, are more finicky than grownups when it comes to their diet. But calves, unlike many children, choose a



healthier diet than their parents. The finding comes from an ARS study aimed at helping ranchers ensure that the nutritional needs of cattle of all ages are met on the range. In the 2-year study, scientists compared the nutritional needs of cattle to what is available to them on the range. In both years, the calves picked plants that contain one-third more protein and about 15% less nondigestible fiber, compared to plants selected by mature steers. That preference underscored the importance of plants needed especially by young, fast-growing calves.

*Ft. Keogh Livestock and Range Research Station,  
Miles City, MT  
Robert E. Short, (406) 232-4970*

**An unlikely combination of insulin and miniature cattle** may help scientists clear up some of the mysteries surrounding dwarfism in humans as well as cattle. The studies are aimed at determining the role that insulin and related hormones play in the growth of livestock. In tests, insulin injections partially reversed some of the hormone abnormalities associated with a type of dwarfism in Brahman cattle that is similar to Larun, a dwarfism in humans. Both types are diabetes-like conditions caused by below-normal blood levels of a hormone, called insulin-like growth factor-1. The injections stimulated the cow's cells to produce the growth factor. Further tests on the cattle may lead to a better understanding and ultimately to a treatment for human dwarfism. The tests were part of a cooperative study conducted with scientists from the University of Florida, Gainesville, FL.

*Ruminant Nutrition Lab, Beltsville, MD  
Theodore H. Elsasser, (301) 504-8281*

**Cattle could be protected longer from ticks and flies** with an ARS-developed method of applying acaricides—chemicals that combat these parasites. The researchers formulated a fluid of tiny polymer beads containing the FDA-approved drug ivermectin and injected it just below the animal's skin. The beads are absorbed by the body. The commercial application method now used consists of a single injection of the drug alone, which provides protection for only about a week. One injection of the improved time-release formulation was effective for 3 months. Each of the time-release beads is from 50-100 microns in diameter—small enough to pass through an ordinary hypodermic needle. This application is more convenient than current injections that must be repeated or solid

implants that require larger needles and cause more animal discomfort.

*Biting Fly and Cattle Grub Research, Kerrville, TX  
J. Allen Miller, (512) 792-0321*

**Increasing the amount of time that it takes for cattle to reach slaughter weight** will produce leaner beef. Researchers fed identical diets to cattle of the same genetic type, but geared the diets so that the cattle would reach a designated carcass weight at different ages. The result: 22 percent of the variation in fatness was associated with number of days on feed. The study also showed that when steers on different diets were fed to the same weight at the same age, an additional 28 percent of the variation in fatness could be attributed to nutritional factors.

*Production Systems Research, Clay Center, NE  
John W. Keele, (402) 762-4251*

**Veterinarians and pork producers** will soon be reading advertisements for antibiotics that work against *Serpulina hyodysenteriae*. But there's no cause for alarm; that's just the new name for the same organism that's always been behind swine dysentery. ARS researchers traced the evolution of the organism, previously known as *Treponema hyodysenteriae*, and found it's not related to *Treponema pallidum*, which causes syphilis in humans. So they gave the organism the new name *Serpulina*, which means "snake-like," to describe its "s"-shape. The name change was officially announced in the International Journal of Systematic Bacteriology.

*National Animal Disease Center, Ames, IA  
Neil S. Jensen/Thad B. Stanton, (515) 239-8288*

**Thin may be in except when growing orchardgrass**, a popular Midwest pasture plant for cattle. In lab studies, orchardgrass with wide leaves was 3 percent more digestible than with the slim leaves. The difference can translate to an even greater increase in animal weight gains because animals tend to eat more when they're fed a more digestible forage. The information on leaf width could help plant breeders simplify their screening of thousands of orchardgrass genotypes in the search for more digestible forages.

*Field Crops Research, Ames, IA  
Dwayne R. Buxton, (515) 294-9654*

**Russian wild rye may be the newest entry** on the cool-season forage menu. In two years of field studies,



this grass offered grazing six months a year, and was ready for cattle again within a month of being nibbled right down to the ground. Preliminary information indicates it's adequate to meet stocker cattle's nutritional needs, offering about 60 percent digestibility and 12 percent crude protein. Costs of establishing Russian wild rye versus wheat pasture are similar. But the wheat, while more nutritious, must be re-established every year. Russian wild rye will persist several years if it gets enough rain. Researchers say the rye also would reduce soil erosion.

*Grazinglands Research, El Reno, OK  
Daniel P. Mowrey, (405) 262-5291*

Cattle have passed their first tests for reseeding remote rangeland areas by planting seeds in their fertile manure. Such reseeding would be a big favor for ranchers. Today, it is too expensive or simply impossible to get grass-seed planting machines into remote or rugged areas. ARS scientists are testing strategies in which they feed seed-containing gelatin capsules to cattle. The capsules dissolve as they pass through an animal's digestive tract and release grass seeds. The animals excrete the seeds in their manure 2 or 3 days later. In tests, several species of grass seed sprang to life in the manure—a moist, fertile growing environment. With adequate rainfall, the plants can develop into lush range grasses that can feed hungry cattle and wildlife.

*Range Management Unit, Las Cruces, NM  
Jerry R. Barrow/Kris M. Havstad, (505) 646-4842*

Mesquite and other woody shrubs are aggressively crowding out high-quality forage needed by livestock, pronghorn antelope and other animals on southwestern rangeland. But where chemical controls are practical to control shrubs, scientists want to know how often chemicals should be applied to protect the environment. To find out, scientists examined range that had been chemically treated during the past 60 years. They found that the most effective control was at 20- to 30-year intervals. In a separate study, where shrubs weren't controlled, scientists measured an increase of 8 honey mesquite shrubs per acre every year. Studies indicate that such increases need to be reduced to maintain forage productivity on more than 90 million acres of range in Arizona, New Mexico and Texas.

*Range Management Research, Las Cruces, NM  
Robert P. Gibbens, (505) 646-4842*

Farm-raised shrimp thrive on feed that includes low-budget soymeal, according to new tests by ARS researchers in Illinois and Hawaii. More U.S. soymeal might be exported for aquaculture feeds if this preliminary finding is confirmed. Feed is the costliest element in shrimp and fish farming. Most high-quality shrimp feeds are made with expensive protein from sources such as squid, fish or shrimp-head meal. Some contain soymeal as a partial replacement for these pricier ingredients. Earlier ARS research found that shrimp thrive even if soymeal makes up as much as 30 percent of the feed. In the new test—a comparison of six soy-based feeds—shrimp put on the most weight with feed containing the cheapest, least processed soymeal. That feed had 28 percent soymeal. At this rate, the American Soybean Association projects a potential annual \$40 million market by 1994 for U.S. soymeal at aquaculture feedmills in Indonesia, Thailand, the Philippines, Malaysia and India.

*Biopolymer Research Unit, National Center for  
Agricultural Utilization Research, Peoria, IL  
David J. Sessa, (309) 685-4011*

*Tropical Aquaculture Research Unit, Kaneohe, HI  
Chhorn E. Lim, (808) 236-7421*

## Human Nutrition

Nursing mothers would be wise to avoid calorie-slashing diets to lose the weight gained during pregnancy. Such diets may deprive them of the extra protein their bodies need to maintain muscle while producing breast milk. Ten nursing women recently studied were consuming 33 percent more protein than the current Recommended Dietary Allowance for lactating women. They lost less than 3 pounds on average in the six months after delivery. And none of that loss came from lean tissue. Earlier studies showed that getting only the recommended amount of protein puts nursing mothers in a protein deficit and suggested that some of their protein loss may be coming from muscle. Getting one-third more protein than currently recommended, however, prevented a deficit and appears to be closer to the actual need. The intakes of study volunteers indicate that healthy nursing mothers in the United States generally get ample protein. For a 140-pound woman, that translates to about 100 grams of protein per day. But dieters, low-income women and adolescents may be undercutting their needs. A cup of low-fat cottage cheese, 3 ounces of tuna white



meat packet in water, or a 3.2-oz envelope of dried, non-fat buttermilk adds about 30 grams of protein to the diet and only 135 to 325 calories.

*Children's Nutrition Research Center, Houston, TX  
Kathleen J. Motil, (713) 798-7180.*

**An iron-binding protein found in human breast milk** may do more than protect infants' intestinal tracts against infection. That's one known role of lactoferrin, which literally means "milk iron." It is not currently added to infant formulas in the United States. Now, researchers have found that a significant portion of the lactoferrin fed to premature infants ended up in their urine—intact. This larger than average protein survives absorption through the intestinal wall, circulation in the blood, and filtration through the kidneys instead of being broken down into amino acids. The researchers speculate that it may be involved in regulating the development and function of infection-fighting cells in infants because it is also found in immune cells of adults. They are working to identify all human milk proteins that serve as more than building blocks in order to design infant formulas that mimic mother's milk.

*Children's Nutrition Research Center, Houston, TX  
T. William Hutchens, (713) 798-7053*

**Extra vitamin C at each meal can help women get more iron from the less available sources—vegetables, grains and legumes.** In a 10-week study, women of childbearing age ate a diet very low in meat and high in plant foods from which iron is harder to absorb. During half the experiment, they got a 500-milligram vitamin C supplement with each meal; during the other half, a placebo. The supplement didn't increase either blood hemoglobin or iron reserves, but it significantly boosted the active thyroid hormone, T3. Studies with rats have shown that iron deficiency reduces levels of T3, which regulates the body's metabolism. The results support findings from earlier studies showing that vitamin C can enhance iron absorption from plant foods. Getting enough iron has long been a problem for younger women and may be becoming more so among those who cut back on consumption of red meat. Adding a glass of orange or grapefruit juice or a serving of fresh strawberries or broccoli to meals can help overcome the problem.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Janet R. Hunt, (301) 795-8328*

**Skimping on vitamin C** lowers the body's concentration of another compound important for good health. Scientists with ARS and the University of California at Berkeley and Los Angeles ran the 13-week investigation with 8 male volunteers to learn more about effects of low daily levels of vitamin C. The Recommended Dietary Allowance is 60 milligrams. But the scientists found that a compound called glutathione fell 50 percent when the men consumed less than one-third the RDA. Glutathione helps guard against heart disease, cancer and inflammatory diseases such as arthritis. Scientists already knew that a low intake of vitamin C weakens the body's disease defenses. But the new study is apparently the first to show that lowering glutathione is another path by which a low-C regimen impairs defenses. Once the volunteers in the new study raised their vitamin C intake, glutathione increased. Fruits and vegetables are good sources of the vitamin, especially strawberries, kale, broccoli, citrus fruits and green peppers.

*Micronutrients Research Unit, Western Human  
Nutrition Research Center, San Francisco, CA  
Robert A. Jacob, (415) 556-3531*

**Women who have lost their get-up-and-go** may be suffering from low iron reserves, even though standard blood tests don't indicate anemia. Findings of a rat study have implications for at least 20 percent of U.S. women of childbearing age who test low for iron reserves (the iron not associated with blood hemoglobin). The rats' activity level decreased as their iron reserves decreased. The animals that got a low-iron diet were significantly less active in the dark—when rats are normally most active—than the group getting adequate iron throughout the 2-month study. While tests for hemoglobin and hematocrit levels were normal in the low-iron group, iron reserves (non-heme iron) were below normal. In people and animals, hemoglobin and hematocrit are the last numbers to slip when iron intake is inadequate because the body will deplete its reserves to maintain its oxygen-carrying capacity.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Janet R. Hunt, (701) 795-8328*

**A zinc-deficient diet may interfere with male fertility** in a relatively short time, according to a study of 11 men. They consumed 5 different levels of zinc, ranging from 10 percent of the Recommended Dietary



Allowance to 70 percent. The RDA is 15 milligrams per day. After 5 weeks of getting only 10 percent of the RDA, semen volume dropped one-third and blood testosterone levels one-fifth, compared to when the men were getting 70 percent. Since the concentration of zinc in semen didn't change throughout the study, the body apparently tries to hold on to dwindling supplies of the mineral by reducing the volume of ejaculate. However, a diet with so little zinc is far from typical. The study diet contained little of the good sources of zinc—meat (particularly beef), whole wheat products, nuts and legumes, oysters and other shellfish. On average, U.S. men get about 85 percent of their zinc RDA, which is considered adequate for most men.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Curtiss Hunt, (701) 795-8423*

A hormone-like substance called thromboxane could someday join cholesterol as a risk indicator for heart disease. A new ARS study using 40 volunteers—the largest of its kind—confirms that certain fats in fish oil help hold thromboxane to healthy levels in arteries. Researchers also came up with a more accurate way to measure the substance. Released by blood platelets, thromboxane helps to regulate arterial blood flow. It also encourages the platelets' blood-clotting function. But, just as too much cholesterol in an artery is like sludge clogging a hose, too much thromboxane narrows the hose—raising blood pressure and heart disease risk. Too much thromboxane also tends to increase unwanted blood clotting in an artery. For part of the 28-week study, the volunteers got a daily 15-gram supplement of fish oil in their controlled diet. Result: they excreted at least 15 percent less of a thromboxane byproduct, 11-dehydrothromboxane B-2, in their urine. That means their platelets released less thromboxane. Researchers will use the new measurement method in future studies. They want to see how fish oil and other fat sources affect the ratio of thromboxane to its counterpart, prostacyclin, which dilates arteries and hinders blood clotting.

*Lipid Nutrition Laboratory, Beltsville, MD  
Aldo Ferretti, (301) 504-8306*

A closer look at blood platelets by ARS researchers could lead to a new test to determine which fats in the diet raise or lower the risk of heart disease. Platelets' main job is to halt bleeding. Imagine them beginning

as empty balloons, which then become inflated, grow spikes and interlock with other spiky, swollen platelets. Heart disease is linked to "hyperactive" platelets. That means too many are round and swollen. In this form, they increase unwanted clotting and impede normal blood flow within an artery. The new approach measures the platelets' change toward roundness from a disc-like, unactivated form, which promotes blood flow. ARS scientists pursued the platelets' change after an intriguing finding from a 28-week diet study of 40 human volunteers. Fish oil fats in the diet, they found, increased the proportion of disc-like platelets. In a follow-up study with rats, scientists saw similar effects. They also determined the best conditions for collecting platelet samples. Now they can plan new studies of platelet activation in lab animals and human volunteers. The research could help nutritionists and physicians design more healthful diets, especially for people at higher risk of heart disease, diabetes and other chronic ailments.

*Lipid Nutrition Laboratory, Beltsville, MD  
Norberta Schoene, (301) 504-8306*

Data from a Mt. Everest expedition is shedding new light on energy requirements for human survival under harsh environmental conditions. The results could help military planners devise troop diets, and international relief agencies ration daily food supplies to sustain human lives in emergencies like last year's efforts in Turkey to aid Kurdish refugees. During the expedition, the 10 climbers burned an average of 5,148 calories daily at altitudes up to 29,000 feet; four of them actually burned between 6,000 and 8,000 calories daily. Five others who maintained the 17,500-foot elevation base camp, burned an average of 3,286 calories per day. By contrast, a marathoner burns 3,200 to 3,400 calories on race day. The climbers and base-campers ate only 50 to 60 percent of the calories they burned daily; consequently, the climbers averaged a 13 percent weight loss, and the base-campers 10.4 percent. Other expeditions have experienced losses up to 30 percent.

... The 1989 expedition study was coordinated by a former ARS nutrition researcher and climbing enthusiast to determine what types of foods may improve performance and reduce physical and mental trauma at extreme altitudes. Expedition members selected tasty, easy to prepare foods which they felt would produce optimum performance and comfort under such harsh



conditions. As a group, the 15 men and women averaged 30 percent total calories as fat—even though extra fat would have provided more calories. Individually, fat intake ranged from 23 percent to 40 percent. Carbohydrates contributed 52 percent of the team's average daily calories, ranging from 41 to 60 percent on an individual basis. The low oxygen at these altitudes may have triggered their desire for lower fat foods because it takes less oxygen to derive energy from carbohydrates than from fat.

*Vitamin and Mineral Lab, Beltsville Human Nutrition Research Center, Beltsville, MD  
M. Patricia Howard, (301) 344-2459  
University of Illinois at Chicago  
Robert D. Reynolds, (312) 996-1207*

## Biological Control

Sex can be deadly for fall armyworm pests that spread a parasitic worm to each other during mating. In lab studies, male armyworm moths infested with the parasitic worm, called a nematode, passed it to females 48 percent of the time during mating. Scientists found that the nematodes quickly multiply on both sexes of moths: a population of five nematodes on newly infested moths increased to about 400 within 7 days—enough to reduce the number of eggs that hatch. If field tests confirm the lab studies, the nematode, *Noctuidonema guyanense*, could be a potential biological control for armyworm caterpillars, which cause up to \$300 million in damage each year to corn, grasses, vegetables and other crops.

*Insect Biology/Management Systems Research,  
Tifton, GA  
Charlie E. Rogers, (912) 387-2330*

Tomato hornworms and corn earworms that plague gardeners and farmers were felled by a natural insect virus in lab tests. These crop pests are among more than two dozen species of pesky caterpillars attacked by the celery looper virus. Within 5 years, it might be available as a new, environmentally friendly insecticide. ARS researchers discovered the virus in the pale-green celery looper worm, so named it for that insect. The microorganism doesn't target people, pets or other forms of life. When eaten by a caterpillar, virus particles multiply and kill it within a few days. The worm's body then liquifies. What's left is a virus-

infected fluid that oozes onto leaves or soil for other caterpillar pests to ingest. ARS outdoor experiments in three cotton-growing states this year will track the virus' ability to kill major caterpillar enemies of that crop. The insects include pink and cotton bollworm, yellowstriped and beet armyworm and soybean looper. Cotton bollworms alone cost U.S. growers about \$1.5 billion a year in yield loss and chemical controls. ARS scientists are working with Sandoz Agro, Inc., on the tests, under a cooperative research and development agreement. (PATENT 4,911,913)

*Range Insect Control Research, Kimberly, ID  
Donald L. Hostetter, (208) 423-6518  
Horticultural Crops Research Lab, Fresno, CA  
Patrick V. Vail, (209) 453-3000*

[illegible]





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Department of  
Agriculture

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Beltsville, Maryland  
20705

April 1992

NOTE TO WRITERS AND EDITORS:

Enclosed is the latest Quarterly Report of Selected Research Projects, published by USDA's Agricultural Research Service. If you want more detailed information on a story, each item includes the name and telephone number of a scientist familiar with the project. For general questions, phone Sean Adams or Lisa Spurlock, ARS Information Staff, at (301) 504-9108 or 504-8916 in Beltsville, Maryland.

—ARS research to control the sweetpotato whitefly increased in the late 1980's. See our special research report. (pages 1-3)

—A new flavoring mix boosts the appetizing aroma of tomato soup, spaghetti sauce, salsa and other products from tomato paste or sauce. (page 3)

—Computer-simulated duststorms could soon help farmers and public officials prepare for real duststorms and reduce the threat to crops, air quality and even highway safety. (page 6)

—Fiber optics are giving scientists a new below-ground look at how stress disrupts the nitrogen-fixing process in soybeans, alfalfa and other legumes. (page 7)

—Dead Kentucky bluegrass could be the key to a more natural, environmentally friendly herbicide. That's because the killed grass exudes natural compounds that can hinder other plant growth. (page 8)

—To guard against the fungus that makes aflatoxin, seed companies have begun working with a new strain of corn from ARS scientists. In field trials, the new corn breeding line warded off fungus infections far more severe than what commercial corn experiences. (page 9)

—Dairy cows can be protected from milk fever by a simple dietary change studied by ARS scientists. (page 12)

—Cattle could be protected longer from ticks and flies with an ARS-developed method of applying acaricides—chemicals that combat these parasites. (page 13)

—Nursing mothers would be wise to avoid calorie-slashing diets to lose the weight gained during pregnancy. (page 14)

Sincerely,

Robert W. Norton  
Director

Enclosure

[illegible]



# Quarterly Report

of Selected Research Projects

April 1 to June 30, 1992

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## New and Improved Products

A new way to make cow's milk as easily digestible and non-allergenic as mother's breast milk has been developed by ARS scientists. Cow's milk and breast milk differ significantly in protein concentration, making mother's milk more nutritious and easily digested than cow's milk. But cooling and molecular filtration of cow's milk results in comparable levels of protein, casein and whey found in breast milk. The researchers used salt and adjusted pH levels to remove a protein component in cow's milk that can cause allergic reactions in infants. Up to now the dairy industry had to use costly separate steps to alter protein levels. But, none of these steps removed allergy-causing proteins. Based on principles of making cheese and other dairy products, the dairy industry can adjust processing methods for continuous production of the modified milk. Several companies are interested in licensing the technology. (PATENT APPLICATION 07/791,691)

*Macromolecular and Cell Structure Research Unit,  
Eastern Regional Research Center, Philadelphia, PA  
John Henry Woychik, (215) 233-6483*

A coloring process to replace the controversial food colorant Red Dye No. 3 in maraschino cherries has been developed and patented by ARS scientists. The new process prevents "bleeding" of dyed maraschino cherries in products

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, Bldg. 419, BARC-East, Beltsville, MD 20705, (301) 504-9108 or 504-8916.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786.

like fruit cocktail and fruit salad. Red pigments, known as carotenoids, are used as the key ingredient and can be produced synthetically or derived from natural sources such as algae and red peppers. Carotenoid pigments are currently approved for food use by the Food and Drug Administration. Two companies are seeking licenses on this patented technique. (PATENT 5,019,405)

*Plant Science Research, Eastern Regional Research  
Center, Philadelphia, PA  
Gerald M. Sapers, (215) 233-6417*

A computer model that gives a new three-dimensional view of an animal skin's fibrous proteins could help tanners and leather processors design hides for various uses. The proteins, known as collagen, are responsible for the strength and toughness of rawhide and the leather made from it. The computer model more accurately shows how collagen molecules are arranged—and should help solve problems in designing new tanning agents that give leather characteristics like softness and strength without damaging fiber. While the basic shape of collagen is known, it's unclear how these molecules pack into fine fibers known as fibrils. These molecular building blocks determine the strength and flexibility of collagen fibers. Understanding how fibers are packed will tell tanners what kind of tanning agents could penetrate and bind a hide's fibers. The model has shown that interactions between collagen molecules are strongly influenced by the number of molecules present at that particular site on the collagen protein. This explains why tanning agents used to modify collagen perform differently at various sites on the protein. The research also is important for replacing existing tanning agents that may be harmful to the environment or pose threats to tanning industry workers, while giving the leather industry more options to expand the type and quality of leather products.

*Hides, Leather and Wool Research, Eastern Regional  
Research Center, Philadelphia, PA  
James M. Chen, (215) 233-6434*

Hide processors can improve curing by using heat instead of cold. That's because salt baths, which are used to cure hides by removing water and saturating with salt the remaining water in the hide, perform faster in warmer temperatures. In one study, ARS scientists found more than 75 percent of the cattlehides cured during winter months in the colder regions of the country had unsatisfactory levels of salt saturation. A fresh hide usually contains about 64 percent water, but salt curing reduces its moisture content to about 45 percent. The remaining water must be



at least 85 percent saturated with salt to prevent microbial growth on the hide. Researchers observed the movement of salt into hides cured at 36, 50, 60 and 80 degrees F to reach their conclusions. These studies also showed that mechanical movement in the bath increases the rate of salt penetration in the hide. Scientists also found that it's important that salt saturation and curing time be coordinated with temperature. If the proper time isn't allowed during cold weather, partially cured hides may look preserved but will degrade more quickly at elevated temperatures.

*Hides, Leather and Wool Research, Eastern Regional Research Center, Philadelphia, PA*  
David G. Bailey, (215) 233-6486

**A new method that turns cornstarch into raw materials** that may be used to make a vast array of products could ultimately provide new multi-million-pound markets for starch. These materials can serve many uses, including as thickeners, absorbents and ingredients of plastics. Such materials are copolymers, made by grafting a chemical onto starch. Others, such as glucosides and additional starch derivatives may be used in a wide range of products including polyurethane foams, resins, surfactants and cosmetics. By using twin-screw extruders, researchers are turning simple cornstarch into these raw materials with potential industrial uses. Rather than being simply mixed, cooked and/or shaped, starch is modified in the extruder, typically through the addition of chemicals and exposure to high temperature, and pressure. Using the twin-screw extruders, this conversion process can be done continuously and more economically than a batch by batch process.

*Food Physical Chemistry Research, Peoria, IL*  
Merle E. Carr, (309) 685-4011

**Using a gel made of organic acids and calcium alginate to kill bacteria on meat** may provide one solution to a nagging food safety issue. Researchers dipped pieces of raw lean beef—artificially inoculated with *Listeria monocytogenes*, a known food-borne pathogen—in a mixture of acetic acid and calcium alginate gel. The acid-gel mixture reduced by 90 percent the number of live bacteria on the meat, whereas acetic acid alone reduced the bacteria only 70 percent. Evaluations were made after keeping the meat refrigerated at 41 degrees F for seven days. Calcium alginate enhanced the ability of the acetic acid to stop the growth of the bacteria. *L. monocytogenes* doesn't grow on frozen meat, but it is able to grow on chilled meat. The Food and Drug Administration allows the use of calcium alginate as a food additive. Alginate gels have been used to prevent shrinkage of sheep carcasses. Additional research is needed before this process is ready for approval by FDA

and USDA's Food Safety and Inspection Service for commercial use.

*U.S. Meat Animal Research Center, Clay Center, NE*  
Gregory R. Siragusa/James S. Dickson, (402) 762-4227

**Carbonated beverages made from milk** could be on the market within a year—the product of a research and development agreement between ARS and a New Orleans company. National Fruit Flavor Co. Inc., which manufactures flavor concentrates, syrups and other ingredients for the beverage industry, is working on several types of beverages—such as iced-Cappuccino, orange juice milk and strawberry milks. They would possibly be available to consumers by January 1993. ARS scientists make carbonated milk from a mixture of reconstituted non-fat dry milk, skim milk and fruit juice. Then, the mixture is kept under pressure and bottled so the carbonation doesn't escape. A market for carbonated milk could help reverse the decline in the consumption of milk. That drop off deprives dairy farmers of income and consumers of calcium needed for the diet. U.S. consumers drink 280 billion containers of beverages annually. Soft drinks are projected to grow at an annual rate of eight percent by 1995.

*Food and Feed Systems Research Unit, Southern Regional Research Center, New Orleans, LA*  
Ranjit S. Kadan, (504) 286-4332

**Coastal Chip is a new potato for the chipping industry.** It does not develop heat necrosis—which causes chips to have an off-color—to the same extent as Atlantic, the most popular variety now used for potato chips. This gives growers more leeway in harvesting before tubers go offgrade. Especially adapted to growing in heat stress areas on the East Coast, Coastal Chip will also produce potato chips of acceptable color for a longer period of time after harvest than most other varieties. Resistant to race A of the golden nematode and potato virus A, the new potato was released jointly by ARS and six cooperating states.

*Vegetable Lab, Beltsville, MD*  
Kathleen G. Haynes, (301) 504-7405

**A promising potato variety shelved by industry because of storage problems** could regain its place as a source of tasty, light-colored potato chips. Crystal was briefly a hot new item a decade ago with commercial producers until storage problems such as bruises and diseases bumped it from favor. But in ARS and North Dakota State University tests, some new plants derived from cell cultures of the variety resisted bruising and Erwinia soft rot. Moreover, the new selections, termed protoplast-derived somaclones, lost less weight from respiration during storage than did the



mother clone. Crystal can be processed directly out of cool storage into high-quality chips.

*Potato Handling, Storage and Processing, East Grand Forks, MN*

*Paul H. Orr, (218) 773-2473*

**A compound in fish oil** that nutrition research suggests could reduce the risk of heart disease and atherosclerosis can now be produced from fungi grown on whey. Previously the only known source of the compound—eicosapentaenoic acid (EPA)—was fish oil. But, ARS researchers found that EPA is produced by four species of filamentous fungi from the genus *Pythium*. ARS grows the EPA-producing fungi by feeding them whey—creating a potential new use for that cheesemaking by-product. Whey disposal has become a problem for the dairy industry because of costs associated with treatment of the waste—about 500,000 tons annually. Because whey has a high level of lactose—a sugar in milk some people have problems digesting—it has limited uses. The Food and Drug Administration has not approved the sale of EPA, but it is being examined in clinical studies sponsored by the National Institutes of Health. If EPA is shown to be beneficial, it will result in a demand for more than one EPA source. The compound is currently sold in some countries in Europe. (PATENT APPLICATION 07/785,375)

*Eastern Regional Research Center, Philadelphia, PA*  
*Dennis J. O'Brien/George A. Somkuti, (215) 233-6601*

**A new irrigation valve senses when and how much water to release** into the soil for orchard and row crops such as strawberries and vegetables. ARS researchers designed the valve so it provides a water flow proportional to the soil's dryness, greatly reducing the amount of water now used in irrigation. Only one moving part is needed to operate the valve, which works without electricity. And, the valve also can be used in the nursery, vegetable, landscape and turf industries as well. (PATENT APPLICATION 07/764,738)

*Appalachian Fruit Research Station, Kearneysville, WV*  
*Donald L. Peterson/D. Michael Glenn, (304) 725-3451*

**Strawberries will be grown in a year or two without the threat of anthracnose crown rot**, a disease that can wipe out an entire crop. ARS scientists released to plant breeders four new strawberry germplasm lines that resist this fungus-caused disease. Anthracnose reached epidemic levels in the 1970's. The new lines—US 70, 159, 292 and 438—also have been bred to resist other diseases. That means they can be grown with less pesticide than normally used. ARS field tests yielded large, bright red, high quality berries. Culti-

vars from the germplasm should be ideal for commercial growers and home gardeners.

*Fruit Lab, Beltsville, MD*

*Gene J. Galletta, (301) 504-7569*

*Small Fruit Research Station, Poplarville, MS*

*Barbara J. Smith, (601) 795-8751*

**Smaller nectarine and peach trees that yield as much fruit as large trees** will be available to growers in a few years. Scientists have bred small nectarine and peach trees that can be planted in higher densities than their big cousins, reducing land and operating costs. Over 1,000 of these new trees can be planted on an acre of land that will accommodate only several hundred larger trees. Other payoffs: the trees require less pruning and are easier to harvest.

*Appalachian Fruit Research Station, Kearneysville, WV*  
*Ralph Scorza, (304) 725-3451*

**Stronger stems keep two new barleys from lodging**, or bowing toward the ground, as easily as other varieties. Standing barley is much easier to harvest, and the grain is less likely to become discolored or diseased than if it lodges. The new barleys—Colter and Targhee—are both high-yielding types to be fed to beef and dairy cattle, as well as sheep and pigs. But a northwest-based company, Great Western Malting Company, is testing Colter as a possible new variety for use in malting and brewing. ARS developed both barleys in collaboration with university scientists from Idaho, Oregon and Washington. Colter is adapted for irrigated areas in Idaho, Colorado and Oregon. Targhee grows well mainly in nonirrigated or short-season, high elevation regions. Seed from both varieties is available from the University of Idaho's Foundation Seed Program.

*Small Grains and Potato Germplasm Research Unit, Aberdeen, ID*

*Darrell Wesenberg, (208) 397-4162*

**A mechanized "sniffer" invented by ARS scientists will help inspectors detect contaminated grain** without their inhaling harmful materials. Under current practice, grain inspectors smell samples to detect unacceptable odors which indicate contamination by microorganisms, fumigants, insects or anything else that would degrade grain or oil seed. But this manual examination carries with it the potential of inhaling dust, mold, spores, biotoxins, fungus or crushed grain particles. The newly invented sniffer eliminates this risk and also uniformly evaluates aromas checked by grain inspectors. Previous attempts to improve

odor evaluation didn't include a filter, and inspectors found it too difficult to sample enough aroma through other devices to accurately evaluate grain quality. The invention could also be used to judge the quality of finished products, such as baked goods. (PATENT APPLICATION 07/758,068)

*Food Flavor Quality Research, Southern Regional Research Center, New Orleans, LA*  
*Peter B. Johnsen, (504) 286-4421*

**Adding innocuous bacteria to disease-causing fungi** can provide better control of hemp sesbania, a weed commonly found in soybeans, rice and cotton. This booster effect from the bacteria could be important in the production of biological herbicides that use minimal amounts of fungal pathogens. In laboratory studies, researchers treated hemp seedlings with bacteria that don't cause disease and spores from a fungal pathogen called *Colletotrichum truncatum*. The addition of the bacteria, called microbial facilitators, boosted disease levels on the hemp by 40 percent compared to treating with the pathogenic fungus alone. The fungus-bacteria mix infected the weed quickly and needed less than six hours of moisture. Unlike microorganisms used to biologically control plant diseases, microbial facilitators need only survive a few hours to be effective.

*Fermentation Biochemistry Research, Peoria, IL*  
*David A. Schisler, (309) 685-4011*

**Environmentally-friendly insecticides** may be developed from new compounds made by fungal structures called sclerotia. In tests, one compound called nominine killed 40 percent of corn earworms when the pests were fed a diet containing 25 parts per million of nominine for a week. The insects that survived were 90 percent smaller than untreated insects. The corn earworm and its cousin, the tobacco budworm, are blamed for more than \$2 billion in damages to crops each year. Nominine is one of 10 insecticidal compounds ARS scientists have identified from the sclerotia of *Aspergillus nominus*, a fungus that has been isolated most frequently from diseased insects. Many of these sclerotial compounds have never been identified before by scientists. The Biotechnology Research and Development Consortium located in Peoria, IL, and its member companies are funding part of the research, along with a grant from the National Science Foundation. (PATENT 5,017,598)

*National Center for Agricultural Utilization Research, Peoria, IL*  
*Patrick F. Dowd/Donald T. Wicklow, (309) 685-4011*

**New experiments with the unique, squash-like chayote** (shy-O-tay) will pinpoint its ideal shipping and storage temperature. ARS researchers want to protect this vegetable's

delectable taste and firm texture while keeping it from sprouting prematurely. Preliminary tests indicate 60 degrees F is best, but this must be validated. Researchers expect immigrants from Central and South America and Asia to boost demand for this member of the gourd family. Chayote tastes a bit like cucumber, but is crisper and lighter. It's high in fiber and a good source of potassium, iron, calcium and vitamin C. In color, the peel ranges from green to yellow to creamy white. The flesh is usually a lighter shade than the peel. Typically, chayote is marketed at about the size and shape of a mango. Its tender shoots and roots also are eaten, and the vine makes an attractive ornament along fences. The U.S. imports nearly 8,000 tons of chayote each year. A native of Central America, it has spread to other tropical and subtropical areas. In the U.S., it's commercially grown in California and in Florida where it's called vegetable-pear and in Louisiana where it's known as mirliton. Its scientific name is *Sechium edule*.

*Postharvest Quality and Genetics Research Unit, Horticultural Crops Research Laboratory, Fresno, CA*  
*Louis H. Aung, (209) 453-3160*

## Biological Control

**Cone-shaped pieces of plastic resembling badminton birdies** are helping gardeners fight over 100 garden and shade tree pests this summer. Inside the cone—marketed as Rescue—is a sex scent, or pheromone, that attracts spined soldier bugs into an area so they will devour gypsy moth caterpillars, Mexican bean beetles, cabbage loopers, corn earworms, and other pests. One cone can attract 50 or more spined soldier bugs in one day, if it is put out one week before the bud-burst of the red maple tree from early March to mid-April. It is the first commercial pheromone attracting beneficial insects. ARS replicated and patented the beneficial bug's natural pheromone, which attracts soldier bugs of both sexes as well as the immature bugs. Sterling International, Inc., of Liberty Lake, WA, obtained an exclusive license for the chemical blend and formulated it into a plastic cone. ARS scientists evaluated the various formulations to find the most effective one. (PATENT 4,600,581)

*Insect Chemical Ecology Lab, Beltsville, MD*  
*Jeffrey R. Aldrich, (301) 504-8531*

**An Italian beetle may soon join the ranks of other insects** imported to gang up on leafy spurge. This weed infests five million acres in 37 states and crowds out plants grazed by cattle. The adult *Thamnurgus euphorbiae* beetle, the size of a pencil point, sports golden hairs on a shiny, red-brown body. ARS scientists discovered adult beetles and their white, wormlike larvae feeding on characias spurge, a



relative of leafy spurge, in a field east of Rome. In preliminary tests, the scientists found that the beetle will eat leafy spurge from Montana. When the larvae feed on leafy spurge stems, seeds aren't produced, limiting the plant's spread. The scientists suspect that the new beetle will place spurge under heavier stress than a different beetle species released earlier. As many as 15 *T. euphorbiae* may attack a single stem, compared to only one of the other beetle, *Oberea erythrocephala*. Plus, the new beetle apparently breeds two generations a year; the other has just one. Before the new beetle is released in the U.S., ARS scientists will carefully test it in European and then U.S. laboratories under quarantine. That's standard procedure to make sure promising weed eaters won't damage valuable plants.

*European Biological Control Laboratory, Montpellier, France*

*Gaetano Campobasso, (33) 67 04 5600*

**A fossilized mite, estimated to be 35 to 40 million years old,** is providing critical information on mites that have potential as biological controls. Found inside a piece of Baltic amber from Denmark, these mites are primitive ancestors of those that today feed on other mites and small crop-damaging insects. Known as teneriffiid mites, these modern-day descendants could become biological control agents to kill other small mites and insects that are pests of agricultural crops. The fossil provided scientists with the first detailed sample of ancestors of the mite family. It allowed them to study the evolutionary link between the ancient mite and its modern ancestors—a link that could provide answers as to how they are related to other species that could also be used in biological controls. This information will aid scientists who identify and classify mites and will help biological control specialists in their quest to locate effective control agents.

*Systematic Entomology Laboratory, Beltsville, MD*

*Robert L. Smiley, (301) 504-6891*

**Corn earworms, beware**—a parasitic wasp from Australia is a potential new enemy. It looks promising in lab studies as a biological control of the earworm and two related insect pests, the tobacco budworm and fall armyworm. The wasp, *Ichneumon promissorius* (no common name), is the only known parasite that attacks corn earworms when they are pupae—ready to emerge from the soil. That timing would open the possibility of a two-pronged attack, by using other parasites such as *trichogramma* to attack the soil-borne earworm during its earlier egg and larval stages. Scientists will continue studies to see how well the wasp can locate native species of the earworm, armyworm and budworm in the field.

*Insect Biology/Management Systems Research, Tifton, GA*

*James Carpenter, (912) 387-2348*

**Chemicals are out and small soil-borne worms may be in** as a way for the U.S. Golf Association to rid golf courses of Japanese beetle grubs. ARS researchers are investigating the potential of the nematode, *Steinernema carpocapsae*, to quell the soil-living grubs that infest about 9,000 of the country's 14,000 golf courses. Grubs burrow in the soil, damaging grass roots so a course eventually turns brown. USGA is seeking environmentally-friendly ways to kill the grubs, because some states are starting to ban insecticides on golf courses where chemical concentrations often are applied seven times higher than on farms. ARS is undertaking the nematode research as part of a Cooperative Research and Development Agreement signed with USGA. Researchers are looking at the nematode as a potential candidate to control these pests that also wreak havoc on cemetery grass, greenhouse and sod farms.

*Application Technology Research Unit, Wooster, OH*

*Michael G. Klein, (216) 263-3896*

**An environmentally friendly control for fruit flies in citrus** could replace insecticides that might be banned by the Environmental Protection Agency. If the ban occurs, the ARS-developed control could protect Florida citrus exports that are valued at \$100-200 million each year. Tests show that spraying citrus with a natural growth regulator—gibberellic acid (GA)—cuts Caribbean fruit fly infestation by at least 80 percent. GA keeps the peel green, firm, and unappealing to female flies looking for soft fruits to lay their eggs. Inside, fruit ripens normally. GA is commercially available and registered to prevent molds on citrus after harvest, so growers won't face a long wait for regulatory approval of the new method. GA treatment could replace the threatened malathion and methyl bromide—the two chemicals currently used in Florida to certify citrus as "fly-free" for export to Japan and other states. If growers use GA, an additional 85,000 acres might become certified fly-free; they aren't certified now because they are too close to preferred hosts such as guavas. If other fruit flies like the Medfly invade the U.S.—or if Caribbean fruit flies invade other citrus states like California, Texas or Arizona—growers would have a control method in place. Other countries like Mexico, which export citrus to the U.S., have expressed interest in GA as a natural control.

*Insect Attractants, Behavior, and Basic Biology*

*Research Lab, Gainesville, FL*

*Patrick D. Greany, (904) 374-5763*

**An inherited gene can mean life or death** to a stored grain pest called the red flour beetle, but the gene is crucial only if it's inherited from the mother, ARS researchers have discovered. They hope this phenomenon, the first of its kind seen in the animal kingdom, can eventually be manipulated in some way to control pests such as the flour beetle, which

infests areas where grain products are stored. When the female parent flour beetle carries the gene, those of her offspring who do not inherit it die. But if only the male parent carries the gene, the offspring are not endangered by failure to inherit it. Another twist to the mystery: The gene has no discernible function of its own. Current weapons against the red flour beetle include fumigants and residual protectants.

*U.S. Grain Marketing Research Lab, Manhattan, KS  
Richard W. Beeman, (913) 776-2710*

Combining pest control tactics may be the best bet for handling insect resistance to *Bacillus thuringiensis* (Bt). Bt, a soil bacterium, has been used for 30 years as a natural pest control, but insects can build up resistance to it. An integrated pest management approach that includes rotation of Bt toxins, mixtures or sequences of toxins, and varying the toxin dosage are among the methods being explored to head off resistance before it intensifies. Insect resistance has been seen when Bt was applied to plants and when diets spiked with Bt were fed to the pests. However, in the case of plants such as cotton that have been genetically engineered to express the Bt toxin, no pest resistance has been seen.

*Biological Research, U.S. Grain Marketing Research  
Lab, Manhattan, KS  
William H. McGaughey, (913) 776-2705*

## Soil, Water and Air

A money-saving "pollution solution" for excess fertilizer could come from a simple test of a leaf's protein and starch levels. Growers of soybeans and other legumes currently have to make an educated guess on whether young crop plants need more nitrogen or ammonia fertilizer. But ARS tests indicate that checking the leaves' protein and carbohydrate (starch) levels can give a more scientifically based answer. The scientists found that these levels indicate how well nitrogen-fixing bacteria in the soil are doing the job for young soybean plants. If the bacteria are working effectively—combining with roots to convert nitrogen to ammonia—more fertilizer isn't necessary. That, in turn, could help protect groundwater, lakes, rivers and streams against pollution by excess fertilizers. The scientists aim to develop a simple and inexpensive test that is as easy to use as soil-testing kits now on the market.

*Climate Stress Lab, Beltsville, MD  
J. Michael Robinson, (301) 504-5607*

Surge irrigation saves water with more types of soil than previously thought, according to ARS engineers. As its

name implies, surge irrigation forces water to rush through furrows on an intermittent basis. Up to now, the technique has been advocated primarily for sandy and gravelly soils. On these soils, water applied slowly and continuously by conventional furrow irrigation percolates too deep for roots to reach all of it. But surge irrigation may also cut water waste for row crops in finer-textured—clayey to loamy—soils, the scientists report. In recent tests, surge irrigation used 10 percent less water to grow grain sorghum in slowly permeable clay loam, with negligible difference in yield. The surge technique also reduced water runoff at the end of the furrows when the on-off surge cycle was 40 minutes or less.

*Conservation and Production Research Lab, Bushland, TX  
Arland D. Schneider, (806) 356-5732*

Soil erosion was reduced when gypsum by-products from fertilizer manufacturing and coal-burning electric power plants were added to soil in lab experiments. ARS researchers tested three soils common to humid eastern states. These soils had slopes of five and 30 percent and were subjected to 1.25 inches of simulated rainfall an hour. A by-product of almost pure gypsum from a special coal-burning technique in power plants was most effective at increasing rain infiltration and reducing soil loss. Soil loss was cut by about one fourth. A type of gypsum left from fertilizer manufacturing did almost as well in reducing soil lost between rows. The by-products work by helping bind soil particles together. Field tests are presently being conducted. These by-products in the future will give farmers an economical and environmentally safe way to control soil erosion.

*National Soil Erosion Research Laboratory, W.  
Lafayette, IN  
L. Darrell Norton, (317) 494-8682*

Restoring erosion-damaged stream habitats in three Mississippi watersheds is underway using new technology. The work is part of the Demonstration Erosion Control (DEC) Project, a cooperative effort among the U.S. Army Corp of Engineers, the Soil Conservation Service and ARS to investigate and demonstrate technology for stabilizing stream channels in 15 Mississippi watersheds. The first project on Hotophia Creek—about four miles north of Batesville—consisted of placing a 2,400-foot ridge of stone along the water's edge at its normal level, extending 14 existing stone dikes to create deep pools, and planting 3,400 willow tree cuttings to stabilize the streambank. Future work will include restoring stream habitats in two nearby watersheds.

*National Sedimentation Lab, Oxford, MS  
Doug Shields, (601) 232-2919*



**A new test for phosphorus** measures this nutrient in runoff water in just 24 hours—at least seven times faster than current methods. If rainfall washes too much bioavailable phosphorus (BAP) off soil, it causes an increased growth of algae in ponds, streams and lakes. Normally, algae provides food for fish, but overgrowth blocks out sunlight and lowers water quality. As a check against this happening, newly developed test strips can be dipped in runoff water, dried and then sent to a lab to get the correct reading. This new test is so simple that farmers and eventually home gardeners will use it. BAP also can be measured easily in remote sites or in areas lacking technical resources. Researchers are working on developing a prepackaged chemical reagent and color chart that make the new method even simpler to use.

*Water Quality Research, National Water Quality Laboratory, Durant, OK*  
Andrew N. Sharpley, (405) 924-5066

**Taking a plant's temperature** might be a simple way for farmers to save water by taking guesswork out of knowing when a plant is thirsty. For the past four years, ARS scientists have irrigated cotton this way, placing a commercially made infrared sensor in a field to monitor plant leaf temperature. They had previously determined that cotton's optimal growth temperature is 82 degrees F. So an automated drip irrigation system was triggered whenever leaf temperature rose above 82 degrees. Scientists compared yields with cotton irrigated at other temperatures and cotton irrigated weekly. In 1988 and 1989, yields were highest using the 82-degree threshold method. In 1990, yields were about the same for the threshold and weekly irrigated cotton, but water use was less than half as much. In 1991, the scientists moved to a private farm with sprinkler irrigation. With sprinkler irrigation, farmers irrigate in three-day cycles, unless they get enough rain to delay irrigating. As a comparison with the rainfall-based method, scientists irrigated based on temperature only, delaying irrigation a day whenever leaf temperatures did not exceed 82 degrees for more than 2.5 hours. This produced more cotton. Next year, scientists will see if they can save more water without harming yield by letting plants stay thirsty for several hours.

*Plant Stress and Water Conservation Research, Lubbock, TX*  
Donald F. Wanjura, (806) 746-5353

**Earthen road embankments**, dams and levees will stay intact a lot longer if the soil is properly moistened and compacted during construction, according to an ARS study. Scientists say the findings could help civil engineers specify compaction requirements to make earth-lined structures far more resistant to erosion caused by water flowing over an

embankment's top. In lab and field investigations, resistance to "overtop erosion" increased five times or more by raising soil moisture as soil was compacted to form an embankment. Similar results were achieved by compacting the soil more forcefully. The trick, say the scientists, is to maintain the optimum combination of soil moisture and density as the embankment is built.

*Hydraulic Engineering Research Unit, Stillwater, OK*  
Gregory J. Hanson, (405) 624-4135

**What looks like a Star Wars film prop** is actually a one-of-a-kind tractor with a soil-sampling device. Taking soil samples is difficult when the crop canopy is tall and the width between rows varies among experiments. The tractor, designed and constructed by ARS scientists, can vary distance between wheels about five to seven feet and adjust itself above the crop about seven to nine feet. A hydraulic soil probe, mounted on the tractor's front, can collect 15 core samples per hour. From a console, the operator can control wheel width, height, position of the operator platform, probe, travel direction and speed. Soil can be sampled anytime during the year—even when corn plants are fully grown—without disturbing the crop. The unit, invented for research, has been used to collect hundreds of samples for several studies on seasonal changes in soil pesticide levels.

*National Soil Tilth Laboratory, Ames, IA*  
Jerry Hatfield, (515) 294-5723

**Stiff ornamental grass hedges from Asia** saved 45 percent of valuable topsoil from being washed off cotton test sites in the mid-South. Fertile soil accumulated as far as 10 feet back from a hedge row of the grass *Miscanthus sinensis* in the year-long study. Soil losses over the growing season averaged 14.1 tons an acre on grass-hedged plots that were tilled, compared to 24.4 tons on tilled plots without hedges. On plots not tilled, the losses were 0.7 tons an acre for hedges and 1.3 tons without hedges. Grasses were planted about seven inches apart about 1.5 feet from the lower ends of plots that had a five percent slope—enough for rain runoff to cause serious erosion. Runoff and soil loss from the cotton test plots will be measured for at least two more years. Other types of grasses for use as hedges are being compared. This summer, hedges of another stiff grass, switchgrass (*Panicum virgatum*), will be tested on a 20-acre soybean field.

*USDA Sedimentation Laboratory, Oxford, MS*  
Keith C. McGregor, (601) 232-2972

## Crop Production and Protection

Technology originally developed to test blood samples may take the guesswork out of how much nitrogen farmers should apply for optimum crop production. The industry developed concept is being adapted by ARS scientists to detect nitrate levels in the soil. Tests are planned to determine the sensor's ability to take continuous nitrate measurements from a vehicle moving across a field. Soil nitrate measurements could help determine the amount of nitrogen that should be applied at a particular point in the field based on the amount of nitrate detected.

*Crop Protection Research, Urbana, IL*  
*John Hummel, (217) 333-0808*

The true identities of MLOs—mycoplasma-like organisms—are being unmasked. MLOs can wreak havoc in a variety of plants ranging from fruit trees and vegetable crops to ornamental plants. But tracking these plant pathogens without cell walls has been difficult because the same MLO can cause different symptoms in different plants. Now researchers are using DNA probes to determine whether seemingly different MLOs are actually related. They have sorted several of the pathogens into genetically similar "clusters," and have further fine-tuned these classifications into "types." The results can lead to new export markets, better protection for U.S. crops, and healthier plants. Up to now, some export markets have been closed to U.S. crops for fear of importing a "new" MLO into an overseas region. Conversely, MLO detection could help ensure that plant material coming into the United States is free of hitchhiking pathogens. In addition, understanding the links between various MLOs may lead to new ways to prevent their spread to healthy plants.

*Microbiology and Plant Pathology, Beltsville, MD*  
*Robert E. Davis, (301) 504-5745*

Borrowing genes from a sugar found in the weed downy brome could boost the growth of forage grasses in the cool temperatures of spring and fall. This would reduce ranchers' reliance on using harvested hay to feed cattle. Toward this goal, researchers have identified complex sugar molecules known as fructans in downy brome. Made from chains of fructose sugar, fructans give the aggressive, grassy weed an alternate energy source when temperatures drop. That's why the weed stays green during winter and puts on new growth early in spring. Researchers are working to identify and clone the genes that enable downy brome (and other cool-season plants) to use fructans. Those genes could then be transferred to warm-season plants, like

bahiagrass, bermudagrass or sorghum, to help them withstand cool temperatures. Scientists estimate that extending the grazing season just two weeks could save a rancher with 200 cattle as much as \$2,800 each year. Another potential bonus: lawns that don't turn brown over winter.

*Forage and Range Research Unit, Logan, UT*  
*N. Jerry Chatterton, (801) 750-3066*

Sweet sorghum could become an alternative to corn as starting material for producing ethyl alcohol—ethanol—in the temperate U.S. just as sugarcane has helped tropical Brazil reduce dependence on foreign oil. In a two-year test, scientists found that stalks of sweet sorghum grown with irrigation in Colorado and without irrigation in Iowa produced similar amounts of sugar that could be fermented into ethanol. With a modest application of nitrogen fertilizer, one of four sorghum varieties tested in Iowa produced enough sugar to make 560 gallons of ethanol per acre. That's about 110 gallons more than normally would be produced from an acre of corn. Surplus corn grown mainly in the Midwest currently is a more economical raw material for producing ethanol than sorghum grown in temperate climates. However, ever-shifting grain prices may deter some companies from investing heavily in the processing. When emerging fermentation technology increases the merit of using whole plants, sweet sorghum may offer a more dependable supply at stable prices because it thrives in diverse growing conditions.

*Sugarbeet Research, Fargo, ND*  
*Garry A. Smith, (701) 239-1350*  
*Field Crops Research, Ames, IA*  
*Dwayne R. Buxton, (515) 294-9654*

A bacterium recently patented by ARS could earn \$500 million more annually for U.S. soybean growers. The bacterium, a lab-produced strain of *Bradyrhizobium*, increased soybean yields by seven percent in a field trial. It does this by boosting the plant's natural ability to make its own nitrogen fertilizer by a process known as nitrogen fixation. Soybeans—like alfalfa, peas, beans and many other legumes—form a symbiotic relationship with certain soil-dwelling bacteria, such as *Bradyrhizobium*. Farmers buy the bacteria and apply them to legume seeds just before planting. ARS scientists altered a *Bradyrhizobium* species and made it more efficient than strains currently available. Under ideal greenhouse conditions, the new bacterium increased the plants' nitrogen content by 50 percent and plant weight by 25 percent. The scientists say the new bacterium, in addition to boosting soybean yields, opens the way to developing improved bacteria for other legume



plants. (PATENT 5,021,076)

*Soybean/Alfalfa Research Lab, Beltsville, MD*

*L. David Kuykendall, (301) 504-5736*

*Soil-Plant Nutrient Research Unit, Fort Collins, CO*

*William J. Hunter, (303) 498-4208*

**Gene switches from fruit flies** are forcing a crucial plant hormone to yield more of its tightly held secrets. The hormone, cytokinin, governs the growth and normal development of plant cells. It moves throughout a plant, but where exactly is it made? How does it work? What genes does it control? Now, ARS molecular biologists have laid the basis for getting some answers. Those answers could lead to improved crop yield and quality through genetically engineering a plant. In the lab, researchers are examining cytokinin's action in gene-engineered tobacco, tomato, peach, mint and other plants. They gave plants a cytokinin gene hooked to a number of different promoters—DNA fragments that can turn a gene on or off like a switch. One promoter came from a gene in the fruit fly, *Drosophila melanogaster*. Normally, when this insect is exposed to high temperature, the promoter turns on this gene, one of several that can help the insect avoid or recover from heat shock. In one series of tests, researchers exposed gene-engineered tobacco plants to 125-degree F heat for an hour. They found that cytokinin, spurred by the fruit-fly promoter, produced much higher levels of several proteins. Next, the researchers will identify these proteins and determine their functions in plant cells. The information will help scientists find out how genes coding for these proteins can be manipulated to benefit a plant's growth and development.

*Plant Molecular Biology Laboratory, Beltsville, MD*

*Ann C. Smigocki, (301) 504-5848*

**Viruses that naturally infect grasshoppers** can be used to kill these crop-ravaging insects. A virus known as *Melanoplus sanguinipes* entomopoxvirus is one of the most promising candidates tested by ARS. At high dosages, the researchers found that it kills the ravaging insects in four to five days. This is a timely solution when range forage is under immediate threat. When that is not the case, low dosages may cost less and provide better long-term control. That's because low rates promote an on-going cycle of disease among the pests. Although the grasshoppers infected at low rates survive longer, the viruses begin to multiply inside them after 12 days. When the grasshoppers eventually die, their cadavers are eaten by healthy grasshoppers, which then become infected.

*Rangeland Insects Lab, Bozeman, MT*

*Stephen A. Woods, (406) 994-4024*

**Planting no-till soybeans into a mulch of dead fall-planted rye** can provide better than 90 percent control of several common weeds in the early days of the soybeans' growing season, tests have shown. This means farmers could reduce their overall herbicide use on no-till beans. The rye is killed with an herbicide two weeks prior to planting soybeans. When necessary, post-emergence herbicides are used to control subsequent weeds. The tests also showed that crop growth was hindered during drought years when the rye depleted the soil moisture prior to planting. However, yields were unaffected when rainfall was adequate throughout the growing season.

*Crop Protection Research Unit, Urbana, IL*

*Edward W. Stoller, (217) 333-9654*

**A gene identification technique called polymerase chain reaction (PCR)** is being adapted by ARS to detect hidden pathogens in plant germplasm more rapidly than ever before. At present, plants often grow months and even years from quarantined germplasm before certain diseases are revealed. PCR amplifies specified sequences of DNA (building blocks for genes) millions of times in just a few hours—thereby producing enough material for quick and reliable genetic finger printing. ARS scientists recently modified the technique to speed the detection of a viroid that causes a major disease of apple germplasm imported from Japan and China. They also used it to identify a new virus associated with a disease of strawberry germplasm. More applications are on the way, they say.

*National Germplasm Resources, Beltsville, MD*

*Ahmed Hadidi, (301) 504-6460*

**Stored grain insects may suffer from serious indigestion** if researchers succeed in boosting levels of certain natural compounds in crops such as wheat, rice and corn. These compounds are proteins that inhibit the insects' digestive enzymes, causing the indigestion. Studies are underway to determine whether the compounds are more potent in a particular crop. If so, one goal will be to transfer the genes responsible for the stronger compound into crops that aren't as well armed. Crops containing these indigestion-causing genes would be less appealing to pests, resulting in less insect feeding on those plants. The enzyme inhibitors would not affect human and livestock digestion.

*Biological Research, Manhattan, KS*

*Karl J. Kramer, (913) 776-2711*

**Burning dead plant material only when accumulation is heavy**, rather than the standard practice of burning annually, could help Old World bluestem grow best on the Southern Great Plains. In a four-year study, scientists found annual

burning reduced forage yields an average of 16 percent, while applying nitrogen fertilizer without burning increased yields several-fold. By restricting occasional burning to low-lying areas where the most dense buildup of dead plant material generally occurs, farmers could protect the soil in higher areas that are more prone to wind and water erosion. Before European settlers arrived, fires typically recurred on native grasslands at intervals of five to 20 years as lightning struck or native Americans intentionally burned off old vegetation.

*Range and Pasture Research, Woodward, OK*  
*William A. Berg, (405) 256-7449*

**An Old World bluestem grass** that won favor for its resistance to the plant disease iron chlorosis now gets high marks as a pasture forage. In recent tests, WW-Iron Master bluestem, released in 1987 by ARS and the Soil Conservation Service, produced more leaves with higher digestibility and crude protein than other varieties. To analyze how well leaves regrow after grazing, scientists harvested four-week-old regrowth each week from early May through mid-September. In late June as forage yields peaked, WW-Iron Master was producing about 11 percent more leaves than the bluestem variety Caucasian and about 37 percent more leaves than Super Cauc. Old World bluestems have been seeded on more than 3 million acres in the Southern Great Plains in the past 10 years, greatly reducing wind erosion.

*Range and Pasture Research, Woodward, OK*  
*Larry M. White, (405) 256-7449*

**Sterile tobacco budworms** may give cotton producers an alternative to insecticides by helping cut populations of this destructive crop pest. In a pilot program in Mississippi, a mixture of 65,000 sterile males and females that carry a sterile male trait were released daily in April and May from 25 sites throughout a 10-square-mile area. All male progeny from matings between the released females and wild males will be sterile and female progeny will carry the sterile male trait. The sterile insect technique has been used successfully in the past to eradicate screwworms, a devastating pest of livestock, from the United States. However, all released screwworms were sterilized by irradiation, whereas the sterile male trait in the tobacco budworm is genetic and is passed from one generation to the next by the females.

*Southern Insect Management Laboratory, Stoneville, MS*  
*Marion Laster, (601) 686-5283*

**Sexual trickery and mutant fungi** spelled doom for a microscopic, soybean-damaging worm in outdoor field tests. The soybean cyst nematode sucks nutrients from soybean roots. It robbed yields to the tune of about \$250 million in 1991. But two new ARS controls could become

safe, effective alternatives to conventional pesticides against the worm. Last summer, an ARS scientist tested her lab-altered strain of *Verticillium lecanii* fungus in small soybean plots. The fungus destroyed 70 percent of the midseason population of nematode eggs. In other plots, scientists tried a compound they devised to mimic the female nematode's pheromone, or sex attractant. Males sensed the phony pheromone everywhere, so they couldn't home in on females. The scientists also tested different, pheromone-related compounds. These reduced nematode populations, and soybean yield was higher than from plants protected by a conventional nematicide. By using a pheromone-related compound along with the fungus, the scientists slashed nematode numbers by 86 percent. ARS is conducting larger tests this summer. The tests are being run under a cooperative R&D agreement with Crop Genetics International, Hanover, MD. (PATENT APPLICATION 07/633,815)

*Nematology Laboratory, Beltsville, MD*  
*Susan L. F. Meyer, (301) 504-5660*  
*Insect Chemical Ecology Laboratory, Beltsville, MD*  
*Albert B. DeMilo, (301) 504-6138*  
*Animal and Plant Health Inspection Service, Hyattsville, MD*  
*Robin L. Huettel (formerly ARS), (301) 436-8716*

**European cucumbers** are typically pampered in greenhouses, but field tests have shown they can grow in outdoor mesh tents as well. These seedless, "burpless" cucumbers bring as much as \$2 apiece in local produce markets. To grow them in the field, producers generally need night temperatures above 60 degrees Fahrenheit and screening material that will keep out pollinating insects; 30 percent shade cloth works well. The cucumbers will grow in either soil or growth media, such as a mixture of peat moss and vermiculite. Fruit finish or quality is also improved if a wind barrier is installed to protect the European cucumber's delicate skin. Yields are approximately 10 cucumbers per plant, and the cucumbers can be grown from mid-May until first frost.

*South Central Family Farms Research Center, Booneville, AR*  
*Donald J. Makus, (501) 675-3834*

**Waxy buildup** may be bad news on kitchen floors, but it can help forages survive dry weather by locking in vital moisture in plant leaves. Even when plant leaf openings called stomates are closed, water can still escape through the plant's "skin" or cuticle. Thicker leaf wax reduces the leakage. Wax loads can vary greatly within a species, according to new ARS research. Studies have shown some members of the weeping lovegrass group of forages have almost three times as much wax as others in the same



group. Researchers are currently analyzing data from two years of field work to pinpoint the degree of water loss with different amounts of leaf wax.

*Forage Improvement Research, Temple, TX*  
*Charles R. Tischler, (817) 770-6523*

**Gibberellic-acid seed treatments** for semi-dwarf rice are a hit with Southern farmers. They used the treatment on half a million acres in 1991, the first year in which it was commercially available. ARS and University of Arkansas researchers found gibberellic acid, a plant growth regulator, elongates the mesocotyl and coleoptile, the first plant parts to emerge when rice seed germinate. Previously, if semi-dwarf seed was planted even a quarter-inch too deep, plants might not emerge, leaving the farmer to either replant or reap only a fraction of his anticipated crop. The researchers, in cooperation with Abbott Laboratories of Chicago, IL, developed the seed treatment. The treatment is designed for rice planted on dry land.

*Rice Production and Weed Control, Stuttgart, AR*  
*Robert H. Dilday, (501) 673-2661*

**Plants must have nickel to thrive**, ARS researchers have found. Nickel is an essential part of an enzyme called urease that breaks down urea so plants can use the nitrogen in the urea. Nickel is necessary for plants to be able to fully use urea fertilizer. Where soil is deficient in nickel, it must be added to the soil to ensure normal plant growth, even if plants get plenty of urea fertilizer. In studies, soybeans, peas, cowpeas, tomatoes, rice and tobacco have been shown to require nickel when grown with or without urea as the nitrogen source. Also, plants without adequate nickel can't absorb enough iron from the soil and can die. Seeds produced from plants deficient in nickel are not viable. These discoveries have made nickel the first element accepted as essential for all plants since the recognition of chlorine in 1954.

*U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY*  
*Ross M. Welch, (607) 255-5434*

**South Texas sugarcane growers could get a break** from the costly pest called the Mexican rice borer, thanks to chemically treated plastic and rubber chips that confuse the pest in its search for a mate. Farmers in Texas' Rio Grande Valley estimate losses to the pest total more than \$4 million annually—as much as a pound of sugar lost per ton of harvested sugarcane for each percent of damage. The chips, each loaded with an artificial copy of the female borer's own sex attractant, cut down on successful borer matings and subsequent pest population booms. In field tests, approximately 20 percent of plant stalk sections

suffered borer damage when chips weren't spread, compared with about four percent damage when the chips were used. The rice borer attractant, called a pheromone, was chemically identified by ARS scientists in 1983. In subsequent field tests, the scientists have studied the best system for delivering the pheromone to the fields. They are working with an Oregon company to develop a commercial version of the chips.

*Crop Insect Pests Management Research, College Station, TX*  
*Ted N. Shaver, (409) 260-9351*

**Twelve wild species of *Ipomoea*, thought to be closely related to sweetpotato**, have been analyzed using molecular markers to determine their exact genetic relationship with the cultivated sweetpotato (*Ipomoea batatas*). Several of these related species possess disease and insect resistance that may be valuable in sweetpotato breeding. For example, a wild *I. batatas* species found in Latin America may contain resistance to the sweetpotato weevil, a serious pest of the crop in Florida. The U.S. Sweetpotato Germplasm Collection now contains more than 500 accessions, some of which contain characteristics such as white flesh, high beta carotene, low sweetness, dwarf growth habit or resistance to various insects and storage rot organisms.

*Plant Introduction Research, Griffin, GA*  
*Robert L. Jarret, (404) 228-7207*

**Farmers' pride may dictate rice be planted in fields that have been plowed clean of weeds**, but Mother Nature isn't so picky. In three years of study, scientists compared rice productivity on fields repeatedly disked in fall and spring; disked several times in spring only; barely disked in spring; and no-till fields where weeds were wiped out with herbicides only. Rice yields were comparable on all treatments, but there was a difference. When production costs such as equipment fuel were calculated into net returns, farmers' profits were better by as much as \$100 an acre with no-till production compared with conventional cultivation.

*Rice Production and Weed Control Research, Stuttgart, AR*  
*Roy J. Smith Jr., (501) 673-2661*

**Simulated flooding** has confirmed that sweetpotato plants are harmed by excessive water in the middle of the growing season. Sweetpotatoes planted in mid-Atlantic, south-Atlantic and Gulf Coast states are frequently hit by storm-induced floods throughout the growing season. Surplus water in the soil rots roots and can substantially lower harvests. To determine the crop's susceptibility, scientists

from ARS and Oklahoma State University subjected plots of "Jewel," "Shore Gold," "Cordner" and "W241" sweetpotatoes to five days of simulated flooding in August (mid-season) and in late September (late season). Marketable yields from mid-season flooded crops were collectively reduced by 36 percent in 1989 and by 53 percent in 1990. Late-season flooding did not affect marketable yields in either year. Sweetpotatoes were deemed marketable if they met commercial standards for size, shape and quality. "Jewel" and "Shore Gold" cultivars produced the highest yields, although no one cultivar consistently produced higher yields in the studies. Further research is needed to determine the quality of stored sweetpotatoes harvested after mid-or late-season floods.

*Genetics and Production Lab, Lane, OK*  
*Vincent M. Russo, (405) 889-7395*

**Plants, like humans battling the flu, fight back** when hit with infections. Sugarbeets, for example, produce biochemicals that are toxic to invading fungal organisms. A scientist, who has studied 35 beet and beet relatives from around the world, identified two plant-produced compounds that are toxic to the fungus that causes Cercospora leaf spot. Beet breeders might be able to improve resistance to this disease by increasing the levels of the natural toxins. Beets respond quickly by synthesizing the two compounds known as flavonoid phytoalexins, named betagarin and betavulgarin. The compounds retard the spread of the fungus and protect the plant from further damage. The scientist's findings support the idea that Cercospora leaf spot, which is present wherever sugarbeets, fodder beets, table beets and chard are grown, may have evolved with the beets and may help explain why all beet plants examined were able to produce the same two toxic chemicals.

*Sugarbeet Production Research, Ft. Collins, CO*  
*Susan S. Martin, (303) 498-4212*

**A rootstock named Bruce** could become a new bodyguard for California plum and prune orchards threatened by a soil-dwelling worm. A rootstock is the lower, rooted part of an orchard tree, to which the upper, fruit- or nut-bearing portion is grafted. ARS experiments showed that Bruce, descendant of a native American plum, is resistant to the worm, the microscopic root lesion nematode. Bruce outperformed 150 other rootstocks from ARS collections in Pullman, WA, Glenn Dale, MD, and Davis, CA. In greenhouse tests, Bruce had 10 times fewer root lesion nematodes than Mariana 2624—a popular plum rootstock. Chemical pesticides used to kill nematodes are increasingly being restricted. That makes resistant rootstock even more important for protecting California's \$1 billion stonefruit and almond industry.

*Horticultural Crops Research Laboratory, Fresno, CA*  
*Craig A. Ledbetter (209) 453-3060*  
*University of California, Kearney Agricultural Center,*  
*Parlier, CA*  
*Michael V. McKenry, (209) 891-2500*

**Plant viruses may be the culprits** responsible for sick, dead or dying grapevines in many young or newly replanted California vineyards. Virus diseases such as leafroll, corky bark and rupestris stem pitting are the prime suspects, according to an ARS researcher's preliminary diagnosis. Vines were examined from 15 vineyards—some of them in Napa and Sonoma valleys, the state's best known wine-producing regions. Not every infected vine dies. But those that don't produce fewer harvestable grapes. Especially vulnerable are small wineries that had to replant vineyards damaged earlier by a root-eating louse. If the newly planted vines become infected by the viruses, these wineries may be unable to afford a second round of replanting. That cost, plus loss of grape production and wine sales, could total \$75,000 an acre.

*Crops Pathology and Genetics Research Unit, Davis, CA*  
*Deborah A. Golino, (916) 752-4568*

**Tiny wasps—harmless to humans—may help combat the oriental fruit fly**, a pest of more than 200 fruits and vegetables. ARS and University of Hawaii scientists are using millions of lab-reared *Diachasmimorpha longicaudata* wasps in experiments on the Hawaiian island of Kauai. Over the next two years, the scientists will see if the ant-size, black-and-amber wasps will significantly reduce oriental fruit fly populations. The wasps are lab-reared because not enough of them live in Hawaii to quell the fruit flies. Female wasps lay a single egg inside the fruit flies' wormlike larvae. Eggs develop into immature wasps that eat the larvae. In 1993, scientists will combine the wasps with another tactic—releasing millions of sterilized oriental fruit fly males. Objective: to have sterile males outcompete their wild counterparts in mating so that female flies fail to produce offspring. The sterile male technique has proven successful in controlling some insect pests.

*Tropical Fruit and Vegetable Research Laboratory,*  
*Kapaa, HI*  
*Mary Purcell, (808) 822-7995*

**Experimental tomatoes from ARS** contain less water and up to three times as much of the natural compounds that are condensed to make salsa, catsup, spaghetti sauce, and other products. The compounds, rich in natural fiber and sugar, are known as solids. The industry estimates that, if commercial varieties of the new tomatoes become available, each percentage-point increase in solids could be worth \$70



million a year. Today's commercial tomatoes average about five percent solids and 95 percent water. Removing water during processing is costly. But, some of the research tomatoes have as much as 15 percent solids. A ton of those tomatoes would yield 300 pounds of solids—triple the yield of typical tomatoes. To grow high-solids tomatoes, researchers nurtured bits of leaves and stems with a mix of nutrients and other chemicals, forming new plants. A major U.S. producer of farm and garden seed is testing the best of the experimental tomatoes under a cooperative agreement with ARS.

*Process Biotechnology Research Unit, Western Regional Research Center, Albany, CA*

*Merle L. Weaver, (510) 559-5760*

**A natural insecticide that comes from neem, a tropical mahogany tree,** can give growers and home gardeners alternatives to synthetic insecticides like diazinon, malathion and carbaryl. ARS scientists studied the neem seed extract in the late seventies and identified an active chemical as azadirachtin. Tests showed the extract could control over 80 major insect pests by disrupting hormonal changes in the insect larva, causing death during molting. Neem is effective against greenhouse insects such as whiteflies as well as other pests like beetles, grasshoppers, aphids, weevils, fruit flies, gypsy moths and mosquitoes. The ARS studies helped pave the way for development of commercial products based on neem extract. Three commercial formulations—Azatin, BioNeem and Margosan-O—are registered for use on ornamentals and other non-food plants. Registration for use on food crops is underway. The extract's complicated molecule makes it difficult for these insects to develop resistance to it, unlike synthetic sprays. However, it's not toxic to honey bees, other beneficial insects and earthworms and won't harm birds or humans. ARS scientists currently are looking at other neem-based products for use as a fungicide.

*Florist and Nursery Crops Lab, Beltsville, MD*

*Jim Locke, (301) 504-6413*

## **Animal Production and Protection**

**"Designer" grains that are more digestible** could ease animal waste disposal problems. Management of waste has been a long-standing concern of livestock producers who feed grains to animals in an intensive setting, such as a feedlot or a barn. When an animal can digest more of its feed, less waste results. ARS scientists have previously studied digestibility of other parts of the livestock diet, such as forage. Now genetically altering feed grains such as corn

and barley is receiving new attention from the researchers. Another benefit: Alteration of grains for such specific uses would give feed grain producers a more valuable product to market.

*National Program Leader for Grain Crops, Beltsville, MD*

*Charles F. Murphy, (301) 504-5560*

*National Program Leader for Animal Nutrition, Beltsville, MD*

*Lewis W. Smith, (301) 504-5925*

**Will dairy cows of the future go on radio** to tell a farmer when they're getting sick? It's possible—and they would recover sooner if a new ARS system for monitoring a cow's health passes all its hurdles. The system consists of a tiny temperature sensor placed harmlessly in the cow's udder and linked to a radio transmitter. The transmitter sends the animal's temperature to a computer every 15 minutes. The computer detects changes that can signal a health problem. Scientists originally designed the system to detect mastitis, a disease of a cow's udder that costs the dairy industry about \$2 billion annually. The cost would drop—and cows' discomfort alleviated sooner—if farmers had earlier knowledge that a cow has the disease. Researchers say a radio system also could monitor other temperature-related health conditions in cows. For example, it can detect when a cow is in heat, or estrus—and is ready to be artificially inseminated. Currently, U.S. dairy farmers miss detecting estrus about half the time—with a total annual cost estimated at more than \$200 million annually.

*Milk Secretion and Mastitis Lab, Beltsville, MD*

*Alan M. Lefcourt, (301) 504-8451*

**Embryo transfer technology speeds improvement in breeding beef cattle,** but a new ARS finding can reduce its costs. To produce multiple offspring from superior beef cows used for breeding, the industry relies almost exclusively on an extract from the pituitary gland of pigs. The extract makes the cow shed more than one egg at ovulation. The cow is then bred and young embryos are recovered from her reproductive tract and transferred individually to surrogate mothers. Rising demand for pig pituitary extract, however, has more than tripled its cost in the past 10 years. Now, scientists at six locations found that extracts from horse pituitary glands were just as effective. The horse glands now are discarded at slaughterhouses.

*Ft. Keogh Livestock and Range Research Station, Miles City, MT*

*Robert B. Staigmiller, (406) 232-4970*

**For \$100, the typical southern poultry farmer could save \$9,000 annually** on the electric bill for running fans in the broiler house. ARS scientists devised a wind sensor that

turns off the fans when there's enough wind—two mph or more—to protect the birds from heat buildup. Currently, on hot summer days, many farmers run the fans constantly—wind or no wind. But the new device can cut the fans' running time by 50 percent. A typical poultry producer has four broiler houses and raises 160,000 chickens during the summer. If all producers in the South used the wind-sensor shutoffs, savings could reach \$63 million a year.

*South Central Poultry Research Laboratory, Starkville, MS*

*John D. Simmons, (601) 323-2230*

**Checking up on chickens in a harmless magnetic field** could help breeders get leaner poultry to the supermarket meat case. Physicians use magnetic resonance imaging or MRI to detect everything from tumors to hearing defects. Now, ARS researchers have modified MRI so poultry breeders and scientists can follow muscle and fat development in chickens from the day they hatch. The technique employs a magnetic field to graphically depict soft body tissue. That lets the scientists make computer-generated, three-dimensional maps of—for example—a chicken breast, the most economically important part of the bird. Breeders seeking to produce chickens with larger and leaner breasts would use the "chicken map" to select the best birds for breeding. Besides chicken fat's unpopularity with consumers, it costs producers money. Each year, the poultry industry loses \$500 million in chicken feed that birds use only to make a triangular mass of abdominal fat, which must be discarded.

*Non-Ruminant Animal Nutrition Laboratory, Beltsville, MD*

*Alva D. Mitchell, (301) 504-8868*

**A new wheatgrass forage** that packs an extra half-pound of weight per day on grazing steers is being released to seed growers. At that rate, steers grazing the new cool-season grass called Maska would gain an extra 15 pounds in 30 days. In tests, steers grazing Maska outgained those grazing on two other popular wheatgrass varieties, Oahe and Slate. The difference: Maska is 5 percent more digestible than those varieties. Maska was released cooperatively by USDA, North Dakota State University and the University of Nebraska. In the west, Maska is recommended for use during the cool months of spring and fall when native warm-season grasses are dormant. Foundation seed of "Maska" is available now to certified seed growers, and farmers should be able to buy limited quantities of seed in the fall of 1993.

*Forage and Range Research, Lincoln, NE*

*Kenneth P. Vogel, (402) 472-1564*

*Northern Great Plains Research Laboratory, Mandan, ND*

*John D. Berdahl, (701) 667-3004*

**Feeding canola and soy lecithin to lambs** may give consumers meat that's lower in cholesterol and saturated fatty acids. Researchers fed ram lambs a diet of alfalfa along with whole canola seed and soy lecithin added both separately and in combination. Oil in canola seed is high in unsaturated fatty acids and soy lecithin may increase the absorption of fatty acids in the small intestine. Feeding soy lecithin increased the healthful polyunsaturated fatty acids in lean meat by 18 percent. Feeding whole canola seed reduced saturated fatty acids—which can increase the amount of cholesterol in the body—in lean meat by 9 percent. Feeding the combination of whole canola seed and soy lecithin had little effect on fatty acids in lean meat. Cattle will be tested after further field tests on lambs.

*Meat Science Research Laboratory and Ruminant*

*Nutrition Laboratory, Beltsville, MD*

*Morse B. Solomon, (301) 504-8400*

**Horn flies apparently don't like fescue**, for much the same reason that some cattle producers are wary of this cool-season grass. If fescue is infected with a fungus called an endophyte, it can contain a toxin. While this toxin can cause problems for cattle, it also may reduce horn fly populations. Preliminary results of a cooperative study with the University of Arkansas have shown lower hornfly numbers on cows on tall fescue compared to cows on bermudagrass. Researchers think the toxin goes through the cow's digestive tract and portions end up in manure where flies develop. Flies don't hatch well in the manure, depending on levels of toxin in it.

*South Central Family Farms Research Center,*

*Booneville, AR*

*Michael A. Brown, (501) 675-3834*

**Telling the eggs of the most harmful stomach worms from eggs of those that cause only minor damage** could save farmers money on medicating cattle. Lacking a practical and economical test for the most harmful worms, cattle producers medicate all their stock even though some animals may not need it. ARS scientists have developed highly specific DNA probes that attach to unique genes in the worm's eggs. Now, for the first time, scientists can identify the eggs of the most common stomach and intestinal worms that have been released into the feces of U.S. cattle. These DNA probes will eventually help veterinari-



ans and cattle farmers develop medication programs that will target animals responsible for most of the worm problems in a herd. About 15 percent of cattle may be responsible for up to 80 percent of worm transmission. Medication of these "problem" animals could save farmers a good part of the estimated \$300 million that the worms cost U.S. cattle producers annually in worm medication and lost beef and milk production.

*Helminthic Diseases Laboratory and Biosystematics  
Parasitology Laboratory, Beltsville, MD  
Charlotte M. Christensen, (301) 504-8754*

## Human Nutrition

A streamlined analysis for cholesterol in mixed foods cuts 75 percent of the time and considerable cost off the method currently sanctioned by the Association of Official Analytical Chemists. The new method would be useful to food companies that are analyzing mixed foods, such as chili or meat loaf, to meet labeling requirements regarding cholesterol. Like the official AOAC method, it uses a chloroform-methanol-water solvent system to extract lipids (fat and cholesterol) from the mixed foods, but the remaining steps have been streamlined, updated or eliminated. The simplified method measures cholesterol with a gas chromatograph—standard equipment in most analytical labs. Other methods that don't require solvent extraction are more popular because chloroform can be toxic to workers and is costly to dispose. However, the solvent-extraction method is more versatile, because it allows scientists to measure total fat and assess the composition of fatty acids—polyunsaturated, monounsaturated and saturated—as well as measure cholesterol.

*Nutrient Composition Laboratory, Beltsville Human  
Nutrition Research Center, Beltsville, MD  
Raymond H. Thompson, Jr., (301) 504-8789*

To accurately detect zinc deficiency in people, health professionals and researchers need to assess zinc levels in both blood plasma and urine. In a study at the Grand Forks Human Nutrition Research Center, researchers confirmed that people who score low for both plasma and urinary zinc are truly deficient. But measuring zinc level only of blood plasma can give a false picture of a person's zinc status for

several reasons. Plasma levels tend to remain high despite a low-zinc intake, then fall off dramatically when deficiency becomes severe. Also, an infection or disease can artificially raise or lower plasma zinc. And even people who get adequate zinc in their diets have widely varying levels of the mineral in their plasma. The range for urinary zinc levels also varies greatly, making it hard to distinguish a deficient person from one who is at the low end of the "normal" range when only one measurement is used. Zinc is necessary for protein synthesis in every cell of the body. Rich sources of the mineral include beef, whole grain breads and cereals, shell fish, organ meats and nuts.

*ARS Pacific West Area, Albany, CA  
Phyllis Johnson, (510) 559-6071*

Chromium acts on the body's insulin-secreting cells, new findings show, as well as on the insulin molecule itself. Beta cells in the pancreas manufacture and store insulin until a rising blood sugar level signals them to release it. Now a study of rats fed either chromium-deficient or chromium-sufficient diets shows that the element enables the cells to respond quickly to the glucose signal. The pancreases of chromium-deficient rats secreted 40 to 50 percent less insulin than those of chromium-sufficient animals during the early stages of stimulation with glucose. Chromium helps normalize blood sugar levels, but few people get even 50 micrograms (mcg) of this essential trace element daily—the bottom of the suggested 50 to 200 mcg/day intake. It is known to make circulating insulin more efficient at getting blood glucose into body cells and metabolized. Apparently, it also helps the beta cells secrete enough insulin to handle the glucose from a meal.

*Vitamin and Mineral Nutrition Lab, Beltsville Human  
Nutrition Research Center, Beltsville, MD  
Richard A. Anderson/John S. Striffler, (301) 504-8091/  
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# Quarterly Report

of Selected Research Projects July 1 to September 30, 1992

United States  
Department of  
Agriculture

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## Into the Marketplace

**Editor's note:** With this issue, we are beginning a new section called Into the Marketplace, to highlight the transfer of ARS research and technology to the private sector. The new section includes Cooperative Research and Development Agreements between ARS scientists and private companies, and licenses granted to companies to develop products based on patented ARS research. An ARS scientist is listed at the end of each item as a contact for information. For general information about CRADAs or patent licenses, contact M. Ann Whitehead, National Patent Program, at (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.

### Cooperative Research and Development Agreements

...With Monsanto Co. of St. Louis, MO, for evaluating potatoes that have been genetically engineered to resist viruses. Currently, growers spend about \$250 per acre on pesticides to kill insects that spread the viruses. Reducing reliance on these chemicals could save growers money and

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, Bldg. 419, BARC-East, Beltsville, MD 20705, (301) 504-9108 or 504-8916.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786.

help protect beneficial insects and water quality. And, some pesticides may soon be taken off the market, so effective alternatives are needed to guard against declines in potato yield and quality. ARS scientists are testing popular commercial potato varieties in which Monsanto scientists added genes for virus resistance. To date, the tests have shown complete field protection against two major potato viruses, PVX and PVY. Ongoing tests are similarly promising for potatoes with engineered resistance to leaf roll virus. The primary market will be seed producers who provide seed potatoes to commercial growers.

*ARS contact: Peter E. Thomas, Vegetable and Forage Crops Production Research, Prosser, WA, (509) 786-2226*

...With Wayne Farms Division of Continental Grain Company, Pendergrass, GA to develop processing procedures that shorten aging time for broiler breasts after slaughter. To assure maximum tenderness, chicken breasts are put through a six- to 24-hour aging period before removal from the carcass. Shortening or eliminating this process would save on substantial refrigeration costs. Scientists are studying physical and chemical treatments to reduce aging time under commercial conditions. If procedures can be developed, taste panels will decide if the product meets texture and tenderness the consumer expects at the dinner table.

*ARS contact: Gene Lyon, Poultry Processing and Meat Quality Research Unit, Athens, GA, (706) 546-3418*

...With Tre'ce, Inc., of Salinas, CA, for field-testing man-made versions of natural attractants to monitor pepper weevil populations in the field. ARS scientists identified several compounds believed to be natural attractants for pepper weevils. Information on weevil numbers could help pepper growers decide if and when to apply insecticides. The pepper weevil can seriously reduce yields of nearly all varieties of pepper, even when the weevil is present in such low numbers that it is difficult to detect.

*ARS contact: Robert J. Bartelt, Bioactive Constituents Research, Peoria, IL, (309) 685-4011*

...With Agrigenetics Company of East Lake, OH, for defining the genetics involved in the teamwork between a fungus and corn to fend off attacks by European corn borers. When the fungus *Beauveria bassiana* was applied to hybrid field corn, it colonized and moved within the plants, providing season-long suppression of the corn borer. But some corn hybrids are believed more amenable to *B. bassiana* colonization than others. Scientists will study how



genetics of either the fungus or the corn may be involved in determining that a particular corn hybrid will be a good host for the fungus. Then traditional breeding methods could be used to produce plants that help biological control agents such as the fungus work better.

*ARS Contact: Leslie C. Lewis, Corn Insects Research, Ankeny, IA, (515) 964-6664*

## Patent Licenses

**...To three U.S. companies to use a new gene to stop plant ripening.** The gene, built by ARS scientists, has potential to reduce spoilage and aid marketing of fresher fruits, vegetables and ornamental cut flowers. All three companies—Calgene, Inc. of Davis, CA; DNA Plant Technology Corp. of Cinnaminson, NJ; and Monsanto Co. of St. Louis, MO—can use the gene to genetically engineer tomatoes. DNA Plant Technology has exclusive use of the gene in 16 other fruits and vegetables including banana, broccoli, cucumber, pepper, strawberry and watermelon, and seven ornamentals—carnation, chrysanthemum, geranium, gerbera, lily, poinsettia and rose. Monsanto Co. has rights to the gene's use in apple, avocado, nectarine, peach and pear. In ARS experiments, the gene blocked 99.5 percent of all production of a natural ripening gas, ethylene, in greenhouse-grown tomatoes. Later, scientists applied ethylene to the harvested tomatoes to allow them to ripen. (PATENT APPLICATION 07/862,493)

*ARS Contact: Athanasios Theologis, Plant Gene Expression Center, Albany, CA, (510) 559-5900*

**...To Biotechnology Research and Development Corp. of Peoria, IL, to manufacture starch-encapsulated pesticides that will stick to plant leaves.** The consortium plans to commercialize the new technology, including a formulation of *Bacillus thuringiensis*, a pathogen effective against the European corn borer. ARS scientists developed the new formulation under a cooperative research and development agreement with BRDC. Precooked cornstarch combined with an active insecticide, water, and organic or inorganic chemicals forms granules that will adhere to leaves when applied to a wet surface and allowed to dry. Studies show that encapsulated Bt provides equal or better insecticide control than biological and chemical products currently on the market. Encapsulation does not adversely affect the insecticides.

*ARS Contact: Michael R. McGuire/Baruch S. Shasha, Plant Polymer Research, Peoria, IL, (309) 685-4011*

## Human Nutrition

**Breast-feeding infants may be getting shortchanged on calories if their mothers smoke.** ARS scientists found that mothers who smoke produced 22 percent less milk per day than non-smokers. Generally, there is a rapid increase in milk production two to four weeks after delivery. Smoking mothers in the study did not produce this increase. Also, their milk had low concentrations of fat. Infants need a high-fat diet, and 45 to 55 percent of the calories in breast milk come from fat. Infants can make up the low calorie count by increasing their milk intake. But the low production of milk may leave them nutritionally deficient. This may explain why smoking mothers wean their infants earlier than non-smokers.

*Children's Nutrition Research Center, Houston, TX  
Judy M. Hopkinson, (713) 798-7008*

**Regardless of physical activity, older women's body composition appears to change with the seasons.** In a year-long study of 125 women past menopause, researchers detected significant increases in their muscle and bone mass after the summer-fall period and a significant decrease after the winter-spring period. However, their weight remained the same during the year, and differences in physical activity did not appear to account for the changes. These seasonal ups and downs were seen in the women's arms and legs as well as their trunks. Conversely, fat tissue decreased in the summer-fall period and increased in the winter-spring period everywhere but in the arms. The more active women had the same degree of fluctuation in lean and fat tissue as the less active, suggesting that it may be influenced by seasonal changes in the activity of the brain's hypothalamus-pituitary area. This area regulates several major body hormones, such as the sex, growth, adrenal and thyroid hormones. The gains and losses did not quite cancel one another out, however: By the end of the year, the women had a net loss of muscle in their legs and a net gain of fat in their trunks.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Bess Dawson-Hughes, (617) 556-3066*

**It may be wise to boost the body's vitamin E reserves before beginning an exercise program.** New findings suggest that the vitamin reduces some of the muscle damage that occurs during prolonged exercise by protecting cell membranes from oxidation, thereby preserving the cells' integrity. The findings also suggest that extra vitamin E reduces inflammation of damaged tissue, which can cause more damage. Researchers studied 21 sedentary men, half of whom took 800 I.U. of vitamin E daily for seven weeks prior to running downhill on a treadmill for 45 minutes. The other half got placebos. Each group consisted of young men in their twenties and older men between 55 and 74



years of age. By the twelfth day after exercise, the supplemented group—both young and older men—excreted significantly less of a by-product of fat oxidation. They also had significantly lower blood levels of two substances that trigger inflammation. Earlier studies at this ARS center suggest that the immune system responds to prolonged or muscle-damaging exercise much the same as it does to an infection—by launching an attack against damaged muscle tissue to clear it away for new tissue. But the inflammatory response may get out of control and damage healthy tissue as well.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Mohsen Meydani/Simin N. Meydani,  
(617) 556-3126/3129*

**Overweight women shed more than excess fat** when they follow a rigorous weight-loss regimen. After three months on such a regimen, 14 obese volunteers had significantly fewer problems with PMS-type mood swings, less antisocial or inefficient behaviors and better concentration. The women were given only half the calories they normally ate and were put on a strict aerobic exercise program. Their scores on a standard menstrual distress questionnaire were 40 percent below those given before they cut calories and began exercising. Also, their blood levels of monoamine oxidase dropped when they were dieting and exercising. This enzyme has been suggested as a factor in premenstrual tension. What's more, they lost about 36 pounds on average.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
James G. Penland, (701) 504-8932*

**A better understanding of how bacteria break down fiber** in the human colon could eventually lead to greater nutritional benefits from a high-fiber diet. Plant fiber, composed primarily of cellulose and xylan, cannot be broken down by the human digestive tract itself. However, microorganisms inhabiting the intestines are able to grow on these materials. ARS scientists have cloned genes from a bacterium in the human colon that helps in fiber breakdown. The bacterium's genes produce enzymes that act on the fiber. The scientists are now studying the three enzymes—xylanase, xylosidase, and arabinosidase—and the bacterium, called *Bacteroides ovatus*, to pinpoint their precise role in fiber breakdown.

*Fermentation Research, Peoria, IL  
Terence R. Whitehead, (309) 685-4011*

**Our diets may play a role in general aches and pains** not related to an injury, infection or chronic illness, such as arthritis or migraine headaches. An ARS psychologist analyzed patient records from eight separate nutrition studies for medications dispensed for such non-specific

pain. The studies involved men, young women and women past menopause. In five of them, the live-in volunteers requested pain pills two to three times more frequently when their diets were most restrictive. Low copper intakes prompted significantly more requests from men and older women in three of the studies. In another study, young women took more medication when their diets were low in both calcium and manganese (not to be confused with magnesium). And a group of obese young women in a weight-loss study felt more pain when their calorie intake was cut in half. What's more, the young women in the latter two studies made almost as many requests for pain medication during the non-menstrual phase of their cycles as they did during menstruation. Women typically take a lot more pain medication when menstruating. This analysis is the first to show a link between diet and non-specific pain. The findings need to be repeated in future studies before any recommendations for dietary changes could be made.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
James G. Penland, (701) 795-8471*

**Boron appears to play a role** in how we burn calories. Findings from studies of chicks and rats give more support to the importance of boron in the human diet. Its effects on energy metabolism, however, are subtle and became obvious only when the test animals were under some stress. Vitamin D deficiency causes a number of abnormalities in chickens that get diets very low in boron. They have elevated levels of blood glucose, triglycerides and pyruvate—a primary product of glucose metabolism. Adding a little boron to the chicks' diets markedly decreased levels of all three substances. Boron also reduced blood pyruvate levels in vitamin D-deprived rats fed low-boron diets. And rats that experienced another kind of stress—exercising on a treadmill—also responded to boron. By changing the amount of this element in the rats' diet, the researcher could raise or lower blood levels of an indicator of muscle function during exercise. These findings suggest that boron increases the rate at which animals (and possibly humans) burn fuel and, perhaps, the efficiency by which it is burned. The best way to get boron in the diet is to eat at least five fruits and vegetables every day—which also reduces cancer risk and has many other beneficial effects. Apples, pears and grapes or their juices are the richest sources of boron.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Curtiss Hunt, (701) 795-8423*

**Galactose, a carbohydrate in milk** that is linked to an inherited disease that strikes one infant in every 30,000 to 60,000, has been found in various fruits and vegetables. Working with Ross Laboratories, ARS scientists found galactose in varying levels in 41 fruits and vegetables,

including baby food. A few days after birth, an infant born with galactosemia suddenly begins to vomit, lose weight and become lethargic. Usually the symptoms disappear after milk is eliminated from the diet. Even with a change in diet, some patients show poor growth, mental retardation, speech problems and other symptoms. Along with Auburn University's Department of Nutrition and Food Science, ARS tested baby foods from three companies and found galactose in 12 fruits and vegetables. Applesauce, bananas and squash contained high levels. Galactosemia is not the same as lactose intolerance, which develops when a person (usually an adult) can't digest lactose in milk. ARS is cooperating with medical researchers to determine if affected fruits and vegetables should be eliminated from diets of infants and children who can't tolerate galactose.

*Horticultural Crops Quality Lab, Beltsville, MD*  
*Kenneth C. Gross, (301) 504-6128*

A plant now considered a troublesome weed—purslane—contains high levels of fatty acids, vitamin E and other nutrients, making it a prime candidate as a new vegetable crop. ARS scientists have confirmed that a wild purslane species, *Portulaca oleracea*, contains more of one omega-3 fatty acid than any other green leafy vegetable to be studied to date. A 100-gram serving has about 300 to 400 milligrams of alpha-linolenic acid—10 times more than spinach. Omega-3 fatty acids have been linked in some studies to reduced heart disease and other health benefits, and are essential in building cell membranes, especially in the brain and eyes. Researchers also found that *P. oleracea* contains high levels of vitamin E—about 12.2 mg in a 100 g serving, six times more than spinach. Vitamin E protects cell membranes from breaking down. Previous ARS research showed that purslane would be a possible alternative crop in arid areas of southwestern states. The plant is adaptable to dry conditions and to salty soils often present where land is irrigated. Its fleshy leaves, about the size of a fingernail, have a mild, nutty taste. There's already a market for the crop. Europeans eat it in their salads.

*Weed Science Lab, Beltsville, MD*  
*Helen A. Norman, (301) 504-6471*

Women appear to need a little less dietary copper than men, according to a study of 127 men and women, age 20 to 83. The findings will help in establishing Recommended Dietary Allowances for this essential trace element. Copper is a constituent of several enzymes involved in energy metabolism, the formation of blood hemoglobin and protection of tissues against damaging oxygen free-radicals. Currently, the Food and Nutrition Board suggests a safe and adequate intake range of 1.5 to 3.0 milligrams of copper per day for all adults. Men in the study consumed an average 1.3 mg/day from their self-selected diets, and women averaged 1.1 mg/day. The volunteers appeared to be healthy on these levels. On a pound-for-pound basis, men

and women actually absorbed the same amount of copper from their diets. But the men's higher average weight explains their higher requirement. The study at the Grand Forks, ND, Human Nutrition Research Center also suggested that, after age 70, copper metabolism changes in men and women. But the data on this age group were too limited to draw conclusions for their requirements.

*Office of the Director, Pacific West Area, Albany, CA*  
*Phyllis Johnson, (510) 559-6071*

Copper-deficient mice took 2.5 times longer to dissolve blood clots than mice that got adequate copper in their feed. The finding adds more evidence to a theory that coronary heart disease may be linked to inadequate copper intakes in the U.S. and other industrialized countries. Heart disease patients also take longer to dissolve clots when assessed by the same test done on the mice—the euglobulin clot lysis test (ECLT). Tiny blood clots are part of the plaque-forming debris that accumulates in arteries, gradually narrowing the vessel and reducing blood flow. If clot dissolving is impaired, the clot thickens—and so does the plaque. This finding is among the latest of more than 60 similarities noted between animals deficient in copper and people who have heart disease. Oysters, liver, blackstrap molasses and cocoa are the richest sources of copper, but whole wheat products with the bran, nuts and seeds are good sources, too—especially Brazil nuts.

*Grand Forks Human Nutrition Research Center,*  
*Grand Forks, ND*  
*Leslie M. Klevay, (701) 705-8464*  
*Harvard School of Public Health, Cambridge, MA*  
*Sean M. Lynch, (617) 432-3240*

Copper deficiency interferes with the ability of rats' arteries to relax. This may explain why rats develop high blood pressure when fed diets devoid of copper, and it could have implications for people who consistently eat diets with very low copper levels. In the last decade, scientists have learned that cells lining the arteries are not passive. When stimulated by certain blood-borne chemicals, these cells release substances that cause the adjacent smooth muscle cells to either relax or contract. When the muscle cells are signaled to relax, blood pressure goes down. ARS researchers found that copper deficiency decreased the effectiveness of the relaxing factor in the aorta—the largest artery in humans and animals. In a second study, ARS and University of Louisville researchers saw the same response in smaller vessels, known as arterioles.

*Grand Forks Human Nutrition Research Center,*  
*Grand Forks, ND*  
*Jack T. Saari, (701) 795-8499*



The fact that Americans eat more than reported in national databases was underscored in a new nutrition study. Other ARS researchers reported last year that volunteers in nutrition studies at Beltsville, MD, had under-reported their caloric intake by an average 18 percent. In this study, researchers wanted to determine how much zinc people absorb from typical U.S. diets, so they developed test meals based on the Food and Drug Administration's Total Diet Study. Twenty-eight men and women under age 40 consumed the 200 most commonly eaten foods in the amounts and proportions thought to represent the average intakes of men and women in their late 20s. The diets provided 2545 calories for the men and 1570 calories for the women. After two months, however, the men had lost nine pounds on average, and the women lost 11, even though researchers increased each food by 10 percent during the second month in an attempt to stem weight loss. They concluded that the FDA's Total Diet Study food lists do not provide the calories that adult men and women typically eat. Incidentally, the volunteers absorbed about one-quarter of the zinc contained in this representative diet.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND*

*Janet R. Hunt, (701) 795-8328*

## New and Improved Products

A diminutive spud with orange flesh could become a novel addition to the current selection of potato chips. The egg-size tubers turned up in an ARS test plot of potatoes originating from samples from the Andes Mountains in South America. Breeders from several snack food companies requested samples, and have crossed the plants with their own varieties. Their aim is to come up with a new variety suitable for making novelty, orange or orange-yellow potato chips or other spud snacks. Surprisingly, the potatoes contain very little beta carotene—the natural pigment that gives carrots, sweet potatoes and yams their orange color. Our bodies convert beta carotene to vitamin A. The potatoes do contain high levels of related carotenoids, called zeaxanthin and lutein, found in corn, squash, citrus and leafy green vegetables. To date, the nutritional value of these carotenoids is unknown. But scientists say further research may reveal their potential as antioxidant compounds. Such compounds—which include beta carotene and vitamins C and E—are thought to retard aging and possibly protect against cancer.

*Vegetable and Forage Crops Production Research,  
Prosser, WA*

*Charles R. Brown, (509) 786-3454*

Identification of the food-borne pathogen *Listeria monocytogenes* could be done in hours rather than days with an inexpensive mini-test method developed by ARS research-

ers. *Listeria* suspects are first isolated from a food sample by cultural enrichment. Then the test panel, known as a modified microtiter plate (MMP), along with two additional tests, accurately identifies *L. monocytogenes* suspects in 16 hours. That compares with the five to 10 days required for identification using standard culturing procedures. The miniaturized kit costs substantially less to use than tube-based methods.

*U.S. Meat Animal Research Center, Clay Center, NE  
Gregory R. Siragusa, (402) 762-4227*

A new woody ornamental houseplant is a chance mutation from crossing a kumquat hybrid with citrus. "Centennial," which produces fruit that can be used in marmalade, is being introduced by ARS to nurseries next year. Instead of the dark green glossy leaves of the evergreen kumquat, Centennial retains multicolored, or variegated, leaves throughout the year and grows to about 36 inches. The oval mature fruit is bright orange with variegated colors only faintly visible. Flowers, variegated immature fruit and the bright orange fully mature fruit may be found on a plant at the same time.

*U.S. Horticultural Research Laboratory, Orlando, FL  
Herbert C. Barrett, (407) 897-7340*

Japan now imports about one million pounds of unshelled, American-grown walnuts, thanks in part to ARS researchers. In 1986, Japan's government removed a ban on the American unshelled nuts by adopting procedures ARS scientists had developed for fumigating the walnuts. The technique relies on the standard fumigant, methyl bromide, but it's applied under vacuum pressure at packinghouses. That kills any codling moths hiding inside the nuts. California growers, who produce most of America's walnut crop, now sell about \$500,000 worth of unshelled walnuts each year to Japan.

*Horticultural Crops Research Laboratory, Fresno, CA  
Patrick V. Vail, (209) 453-3000*

To protect pears from "belt burn"—the nicks, tears and bruises suffered from rolling down packinghouse conveyor belts—packers spray the fruit with an all-natural wax. Currently, packers dry this wax coating with hot air up to 140 degrees F. But ARS scientists found that air chilled to 32 degrees F dries the wax just as quickly and is more energy efficient. Further, with hot air, the pears are warmed slightly and it takes about a day longer to cool them down in cold storage rooms. Cool-dried pears also stay firm longer. That's an advantage for fruit that is often stored for months before being shipped to grocers.

*Physiology and Pathology of Tree Fruit Research,  
Wenatchee, WA  
Stephen R. Drake, (509) 664-2280*



Goat meat, also called chevon, may be just the ticket for those who must lower their fat intake but enjoy having red meat on the menu. Scientists compared percentages of fat in roasted or broiled leg, loin, rack and shoulder of chevon, beef and lamb. It's the first time such comparisons have been made. They found that all cuts of chevon were 50 to 65 percent lower in fat than beef and 42 to 59 percent leaner than lamb. The leanest cut was the leg. Although not very popular in the U.S., chevon is enjoyed worldwide. The meat is less moist than beef, but some say the taste is comparable. Chevon is available in grocery stores and butcher shops that specialize in Asian, Caribbean, Latin American, or Mediterranean foods.

*Meat Science Research Laboratory, Beltsville, MD  
Morse B. Solomon, (301) 504-8400*

## Soil, Water and Air

Growing concern about lead poisoning is prompting new interest in a fast, accurate and inexpensive test to measure soil lead that could enter the bloodstream of a child eating soil. Now, Cooperative Extension Service labs in Florida and Maryland have joined Illinois, Minnesota, Texas and Wisconsin in offering the test to homeowners for less than \$15. It was one of the tests used in a recently completed Environmental Protection Agency study of soil lead in Baltimore, Boston and Cincinnati. Unlike other costlier tests, the Chaney-Mielke test uses a mild solution of nitric acid. Shaking the soil in nitric acid approximates what happens to soil in a child's stomach where acidic gastric juices free lead from the soil, allowing it to move into the bloodstream. The test is being used by the U.S. Public Health Service and industries whose workers are exposed to lead contamination. Scientists at ARS and Xavier University in New Orleans developed the test more than 15 years ago.

*Environmental Chemistry Laboratory, Beltsville, MD  
Rufus L. Chaney, (301) 504-8324  
Xavier University, New Orleans, LA  
Howard W. Mielke, (504) 486-7411*

Long-term use of poultry manure as a nutrient-rich, inexpensive fertilizer increases the potential that its phosphorus will be washed into waterways by rainfall. ARS and Soil Conservation Service scientists took soil samples from Oklahoma pastures that had been fertilized with poultry manure over the past 12 to 35 years. Soil samples indicated a two- to 13-fold increase in phosphorus levels compared with unfertilized soils. None of the samples, taken from fertilized soil as deep as six feet, showed any immediate danger to groundwater from contamination by phosphorus or nitrate. But the phosphorus on or near the soil surface is vulnerable to being washed away by runoff. Phosphorus doesn't harm humans, but it can end up in lakes, ponds or reservoirs to be consumed by

oxygen-depleting weeds and algae. Fish and other aquatic life may die if enough oxygen is depleted from water as a result of increased weed and/or algae growth.

*National Agricultural Water Quality Laboratory,  
Durant, OK*

*Andrew N. Sharpley, (405) 924-5066*

Shock waves from sledgehammer blows on farm fields are revealing the location of large bedrock fractures. Such fractures can serve as shortcuts, rushing water with pesticides and fertilizer to aquifers before the chemicals can be diluted, stored or degraded in the soil. A map of these fractures can help farmers decide whether to change the land use or chemical applications over fractures. It could also help farmers decide whether to test well water. Using surface sensors and a state-of-the-art seismic detector lowered down wells, ARS scientists have found the significant fractures extend down no farther than 75 to 110 feet in the shale formations common to central Pennsylvania. The fractures closest to the surface, especially at depths less than 30 feet, were interconnected over large areas, providing numerous routes for groundwater to move quickly to aquifers. By contrast, deeper fractures were unconnected to the shallow fractures or to one another. This means that wells and springs that draw from this depth should be safe from contamination by farm chemicals because the water has been filtered through soil. The findings also argue for encasing and sealing wells down to 30 feet where fractures are continuous.

*Northeast Watershed Research Laboratory, University  
Park, PA*

*James B. Urban, (814) 865-2048*

Only two types of aluminum—a major, natural constituent of soil minerals—are toxic to plant roots, an ARS researcher has found. Aluminum limits crop productivity on a very large scale worldwide, including the eastern and northwestern United States. The identification of these two types—one carrying three positive charges and the other up to seven—was made in experiments with wheat, red clover, lettuce, turnip and soybean. Dissolved aluminum forms numerous chemical types or species when it combines with other dissolved chemicals in the soil. Some of these cannot be separated from one another. Until recently, the relative toxicities of the species were unknown. This hindered researchers' ability to predict the toxicity of a given soil, render the soil nontoxic, and to breed aluminum-tolerant crops. An ARS-developed technique to determine relative toxicities made the identification possible.

*Appalachian Soil and Water Conservation Laboratory,  
Beckley, WV*

*Thomas B. Kinraide, (304) 252-6426*

Nutrient-rich, acidic whey—the liquid left over from making cottage cheese—may help restore the health of



high-sodium soils. Known as "sodic," these unproductive soils cover more than 1.8 million acres of irrigated crop and pasture land, mainly in the western United States. Applying whey to sodic soil boosted barley yields in greenhouse and small field plot tests. The calcium, magnesium and potassium in whey helped remove the plant-stunting sodium in sodic soils. Whey's acidity also made calcium already present in soil more soluble, so it too removed the sodium. Once the excess sodium was removed, soil tilth improved. That aided water infiltration, so thirsty plants could drink. Another advantage: Whey is abundant and inexpensive. U.S. cheese factories produce over two million tons of whey each year. About half is dried and used in food products or for livestock feed, but the rest currently goes to waste. Additional studies will test whey's potential for improving nutrient-poor soils.

*Soil and Water Management Research, Kimberly, ID*  
Charles W. Robbins, (208) 423-6530

**A popular herbicide used to kill grassy weeds in soybeans and other crops is also environmentally friendly, a two-year field study in Minnesota has shown.** Researchers wanted to know how the herbicide, called sethoxydim, affected the environment in the soils and climate of the upper Midwest. They found about 27 percent of sethoxydim, as well as substances produced as the herbicide breaks down, remained in clay loam soil 20 days after application. That compared with about 68 percent of the herbicides atrazine and alachlor, not counting their breakdown products. After weeds were killed in late spring, much of sethoxydim was quickly destroyed by light and water, while some was consumed by microbes in the soil. Also in the study, sethoxydim and its breakdown products leached more slowly through topsoil than did alachlor or atrazine. Sethoxydim is applied in very small amounts per acre—10 times less than atrazine and alachlor.

*Soil and Water Management Research, St. Paul, MN*  
William C. Koskinen, (612) 625-4276

## Animal Production and Protection

**Farm animals that produce medicines and other useful products in their milk are a step closer to reality following the successful interspecies transfer of a gene into pigs.** The gene for whey acidic protein, obtained from a researcher at the National Institutes of Health, switches on only when the sows are lactating, and they produce large amounts of the protein in their milk. The secret of this success is a "genetic switch" that is attached to the gene and turns on and off at lactation. To this switch, ARS researchers hope to attach genes for economically and medically important compounds and insert the combination into milk animals such as cows and goats. Protein C, an anti-clotting drug used to treat heart attack victims, would be a candidate for

the livestock "drug factories." And, a single goat, genetically engineered for blood-clotting factors could produce enough to treat all the world's hemophiliacs. Also, cows could be programmed to produce more milk casein—a protein necessary for cheese making. A 20 percent increase in casein would be worth \$200 million annually to U.S. cheese producers.

*Gene Evaluation and Mapping Lab, Beltsville, MD*  
Robert J. Wall, (301) 504-8362

**A new strategy for immunizing chickens against chicken coccidiosis may come from their cousin—the turkey.** When scientists fed chickens large doses of a coccidial parasite that normally attacks only turkeys, the birds developed immunity to the chicken version of the disease, which costs chicken farmers \$300 million annually. The chickens were fed about one million of the turkey parasites daily for about 10 days. Twelve days later they were infected with *Eimeria tenella* and *E. acervulina*—two economically important species of chicken coccidiosis—but they had the same rate of weight gain as control chickens, which had not been infected by either type of parasite. The scientists speculate that the turkey parasites produced a protein that caused a cross immunity to the chicken coccidiosis. If the scientists can determine what causes this cross immunity, it could lead to a vaccine for chicken coccidiosis.

*Helminthic Diseases Laboratory, Beltsville, MD*  
Patricia C. Augustine, (301) 504-8428

**Mills that grind corn for poultry can save a lot more than "chicken feed" on their electric bills by grinding the kernels more coarsely.** Mills waste energy by grinding corn too fine, ARS researchers have found. Studies showed that fast-growing broiler chickens can thrive on a relatively coarse grind the last three weeks before marketing. In other words, the miller's old saying, "the finer the grind, the finer the feed," is true only for the first three weeks of a chick's life. A mill that grinds 50 tons of corn an hour could save \$50 a day or \$10,000 a year by coarsely grinding most of its corn.

*South Central Poultry Research Laboratory, Starkville, MS*  
Berry D. Lott, (601) 323-2230

**Ranchers can grow more beef per acre by rotating cattle from one fenced grazing area to another rather than letting them continuously graze one big pasture, a three-year study has shown.** When steers were moved regularly among 10 small fenced areas of perennial cool-season grass, the land supported 41 percent more steers per acre. Compared with continuous grazing, this rotational grazing produced 73 to 106 more pounds of steer per acre, depending on the type of grass being grazed. Steers in the study grazed fescue. Greatest gains were seen when the animals ate fescue that



was not infected with a natural pathogen called an endophyte.

*South Central Family Farms Research, Booneville, AR  
Michael A. Brown, (501) 675-3834*

**Instead of aging beef up to 14 days** to maximize tenderness, a shot of calcium chloride will do the trick in a mere 24 hours. Calcium chloride is found naturally in meat, and is approved by the Food Safety and Inspection Service as a meat additive. Meat becomes tender when calcium-dependent enzymes in muscle tissue are activated by calcium. An injection of calcium chloride, using a needle process, immediately following slaughter boosts the muscle calcium concentration in the meat. This activates the enzymes, called calpains, resulting in the same degree of tenderization in one day as normally occurs in 7 to 14 days of aging. Preliminary tests indicate the meat flavor is not affected; however, additional detailed tests are being conducted to assure the technique is not detrimental to flavor. Meat tenderized using this method would be labeled according to FSIS guidelines. This technique could help the beef industry ensure consumers will get consistently tender meat.

*Meats Research Unit, Clay Center, NE  
Mohammad Koohmaraie, (402) 762-4221*

**A more accurate, automated test for tapeworm** in cattle—relying on genetic engineering—could be available in a few years. Relatively rare in this country, the tapeworm parasite, *Taenia saginata*, can infect people who eat undercooked beef. A gene from the parasite itself forms the basis for a cattle blood test that ARS scientists are working toward as a replacement for visual inspections now used at slaughterhouses. The gene produces a protein that, in preliminary experiments, was nearly 100 percent accurate in detecting the parasite's presence—even in very small numbers—in calf blood. The tiny, cyst-like *taenia* parasite is found in the muscles of cattle where it causes a relatively harmless condition known as cysticercosis. Infected cattle are common in South America, Africa, and parts of Europe. (PATENT APPLICATION 07/717,235)

*Biosystematic Parasitology Laboratory, Beltsville, MD  
Dante S. Zarlenga, (301) 504-8754*

**Globemallow—a hardy, drought-tolerant plant** native to the U.S.—could soon become a nourishing addition to the menu for grazing sheep and cattle. And, brilliant orange-red flowers make this plant an attractive ornamental for gardens. Sheep eat the flowers as well as the leaves, according to a four-year grazing trial in Idaho. In spring, animals ate globemallow more readily than crested wheatgrass but less readily than alfalfa—two common pasture plants. Globemallow, however, can grow in regions that get only six inches of rain a year—where alfalfa would

die of thirst. Also, globemallow's calcium and magnesium also may help remedy the cattle disease, grass tetany. The ailment occurs when cattle graze tender young grass having a nutrient imbalance that reduces magnesium's availability to the animal. Researchers plan to identify and breed globemallow varieties with the best forage potential. They hope to make two varieties available to native plant nurseries early next year.

*Forage and Range Research Laboratory, Logan, UT  
Melvin D. Rumbaugh (801) 750-3077*

**Breaking from tradition could boost ranchers' income** as much as 25 percent per acre in high-elevation western meadows grazed by cattle. The key, say ARS researchers, is letting cattle graze the meadows first and cutting the hay later. Traditionally, ranchers first cut the hay and let cattle graze the stubble and regrowth. This practice can lead to a decline in hay quality, since grasses such as meadow foxtail mature before the meadows are dry enough for hay harvesting. Instead, researchers found, cattle get a high-quality diet and show excellent weight gains when they first graze the uncut meadow. Hay can be harvested later for winter feed. The findings can benefit ranchers with native meadow land in Colorado, Montana, Nevada, Oregon, Utah and Wyoming.

*Range and Meadow Forage Management Research,  
Burns, OR*

*Raymond F. Angell, (503) 573-2064*

**Mott elephantgrass is a better forage crop** than many people think. The grass persists well, and steers consistently gain two pounds per day while grazing it. But some southern cattlemen were concerned about the lack of information available on how to get the grass off to a good start in their pastures. Now research has shown planting the grass in early August produces the best "crop" if the planting stock has been well fertilized. Grass from plantings in August was more vigorous than plantings from later dates, and individual plants were larger. When planting stock is not as well fertilized, planting the stand at a later date just prior to frost allows the stems more time to mature and produces adequate stands. This information could allow Mott elephantgrass to become a valuable addition to surprisingly scanty forage options in a subtropical setting.

*Subtropical Agricultural Research Station,  
Brooksville, FL*

*Mimi J. Williams, (904) 796-3385*



## Biological Control

A tiny insect that invaded Florida's vegetable, fruit and ornamental crops has, itself, become a target of federal, state and university scientists. *Thrips palmi* has spread throughout eight counties since being sighted in southern Florida in 1990. It has been found on eggplant, green and wax beans, jalapeno and bell peppers, potatoes, okra, zucchini, cucumbers, passionfruit, mangos, and several ornamental crops. Scientists have begun rearing a special colony of *T. palmi* to evaluate natural controls such as fungi and other disease organisms, nematodes and possible predators or parasites. This is part of a collaborative effort by ARS, the University of Florida, USDA's Animal and Plant Health Inspection Service, the Florida Department of Agriculture, growers, processors, and commodity groups. To date, field trials using several different pesticides, and combinations of pesticides, have not been encouraging—hence the shift in emphasis to potential natural controls.

*National Program Leader for Crop Protection,  
Beltsville, MD*

*Robert M. Faust, (301) 504-6918*

An Australian weevil may soon join the fight to save Florida's Everglades from the invasive melaleuca tree. The weevil, *Oxyopos vitiosa*, was imported during July into quarantine facilities at Gainesville, FL, following careful study overseas. ARS scientists in the United States will now be able to further evaluate its safety as a biological control. The melaleuca tree, also originally from Australia, has recently been classified as a federal noxious weed. The weevil feeds on the growing tips of the branches. This destroys the tree's ability to produce flowers and reduces vegetative growth. Melaleuca may now cover up to 1.5 million acres in southern Florida, and it is invading new areas at a rate of 52 acres per day. It grows richly in the Everglades swamps, crowding out native vegetation. The tree reportedly takes in water four times faster than native sawgrass. Researchers are studying the weevil's dietary preferences to make sure that it won't adversely affect other plants and wildlife. On the average, about two years of quarantine study are needed before natural controls can be released into the environment. This control method has a perfect safety record. Over 200 insect species have been introduced to control weeds in various parts of the world, and none have ever become pests on plants other than the intended target. However, control is not immediate. It takes time for the insect population to catch up with the weed population. While this weevil prefers saplings, scientists believe it also will attack new growth on mature trees. Melaleuca is not a problem in Australia because it is naturally kept in check by *O. vitiosa* and other native enemies.

*Aquatic Plant Management Laboratory, Fort  
Lauderdale, FL  
Ted Center, (305) 475-0541*

Leafy spurge is a weed without an enemy in the U.S. and Canada because it left the pathogens, insects, and diseases that control it in its Eurasian homeland nearly 120 years ago. Researchers are looking for the origin of the North American leafy spurge to find new biocontrols that will combat the weed here because chemical control often exceeds the value of the land being treated. For example, ARS and University of Nebraska researchers used high-tech methods to compare Eurasian and North American spurge populations. Using restriction fragment length polymorphism (RFLP) to make DNA "fingerprints," they found that populations of Montana leafy spurge were identical to populations of spurge from Russia. Leafy spurge from Nebraska only differed by one fragment from the Montana and Russian spurge populations. Further studies in collaboration with scientists from the Smithsonian Institution in Washington, DC will be conducted to identify how Eurasian and North American populations are related. Leafy spurge infests five million acres of grassland and pasture in the northern and central Great Plains.

*Wheat, Sorghum & Forage Research, Lincoln, NE  
Robert A. Masters, (402) 472-1546*

A European weevil and a fungus might halt the spread of gorse thickets—sometimes called nature's own barbed wire. A spiny weed found in western parks and pastures, gorse crowds out plants that are good forage for cattle and other grazing animals. And gorse spines spear unwary hikers. Native to western Europe, gorse has invaded California, Washington, Oregon, and Hawaii. The weevil, collected in Spain but not yet identified, feeds on gorse's bean-like seed pods. The fungus, after entering bean pods through holes chewed by insects, infects the gorse seeds and causes them to shrivel and die.

*Plant Protection Research, Albany CA  
B. David Perkins/Charles E. Turner, (510) 559-5975  
European Biological Control Laboratory,  
Montpellier, France  
Luca Fornasari, 33-67-04-56-00*

To help stop the spread of a thorny weed now in 23 states, a weevil from Europe has been turned loose in the U.S. for the first time. The weed spears hikers, poisons horses, repels cattle, and crowds out range and pasture plants. After extensive tests by ARS researchers in Europe and the U.S., brown, quarter-inch-long *Larinus curtus* weevils were set free in California, Oregon, Washington and Idaho in July. Adult weevils feed on starthistle flowers. Weevil eggs hatch into wormlike larvae that destroy developing seeds. The weevil is the fifth in a series of



insects ARS researchers have scrutinized and then supplied to states with the heaviest infestations of the weed.

*European Biological Control Laboratory,  
Montpellier, France*

*Luca Fornasari/Rouhollah Sobhian, 33 67 04 56 00*

*Plant Protection Research, Albany, CA*

*Charles E. Turner, (510) 559-5975*

**A gout medication, allopurinol, stomps out cockroach populations in four to six weeks, ARS studies show.** Allopurinol relieves gout pain by preventing a buildup of crystallized slivers of overabundant uric acid around a person's joints. In cockroaches, it prevents reproduction by depriving a cockroach mother of the uric acid she needs to form embryos in her eggs. Tests show that cockroaches eat rat chow laced with the drug just as well as regular chow. Federal approval would be needed for allopurinol's use to control roaches. Several companies have expressed interest in commercializing the new technology. (PATENT 4,857,532)

*Medical and Veterinary Entomology Research  
Laboratory, Gainesville, FL*

*Daniel R. Suiter, (904) 374-5910*

**After proving that four different compounds kill honey bee mites, ARS researchers have provided data to help private companies quickly register them.** Varroa and tracheal mites, which have spread to 49 states since the early 1980s, weaken honey bee colonies and can wipe them out entirely. ARS research proved that fluvalinate, amitraz and formic acid kill Varroa mites, while menthol, amitraz and formic acid kill tracheal mites. Agency scientists provided technical assistance to companies wanting to market the compounds. As a result, beekeepers now legally use three of them. The fourth, formic acid, is currently being evaluated by regulatory agencies for approval. The compounds have reduced colony mortality and improved bee health, resulting in better honey production and pollination. That has meant millions of dollars a year to beekeepers. And menthol and formic acid have an added benefit: they are naturally occurring materials, so beekeepers can maintain honey's reputation as a safe and natural food.

*Bee Research Lab, Beltsville, MD*

*Hachiro Shimanuki, (301) 504-8975*

**Natural compounds from plants will deter northern fowl mites, which cost U.S. egg producers an estimated \$80 million a year in lost production and veterinary drugs.** In ARS tests, three natural compounds prevented greater than 90 percent of the mites from feeding on chicken blood, and 10 others reduced the mites' feeding. Scientists want to determine if the compounds—from sources such as peppermint, lemongrass, and American pennyroyal plants—can

work as repellants in chicken cages. The mite, which is difficult to control, reduces egg production and causes anemia and sometimes death in laying hens.

*Livestock Insects Laboratory, Beltsville, MD*

*John F. Carroll, (301) 504-9017*

**A new species of nematode—a microscopic worm-like organism that lives in the soil—seeks and destroys caterpillars that damage corn, cotton, tomatoes and many other crops.** The new nematode, discovered by ARS scientists, wiped out 90 to 100 percent of corn earworms in preliminary tests in cornfields. Although other nematodes are known to kill various insect pests, the new one is likely to be the most effective earworm killer so far. Scientists dubbed it *Steinernema riobravus*, after Rio Bravo—the Mexican name for the Rio Grande. Corn earworms, or *Helioverpa zea*, cost U.S. corn farmers \$1.5 billion in damage and control each year. They are also known to growers as cotton bollworm, tomato fruitworm and soybean podworm. After nibbling on crops, the caterpillars burrow into the soil and become pupae, the stage during which they transform to adult moths. *S. riobravus* nematodes wriggle inside a caterpillar or pupa and release bacteria that kill the pest within 48 hours. The nematodes then feed on the dead insect. Researchers mixed the nematodes in water and poured them on the field for the initial tests. For larger tests now underway, they applied the nematodes in irrigation water in furrows or sprinklers. (PATENT APPLICATION 07/883,434)

*Subtropical Cotton Insects Research, Weslaco, TX*

*Jimmy R. Raulston, (512) 969-4807*

**Compounds that mimic chemicals found in natural attractants of boll weevils may provide cotton growers with longer-lasting lures.** Such attractants, called pheromones, are often used in lures to monitor, confuse or trap weevil populations which can infest cotton crops. But aldehydes—chemical components in the pheromones—break down when exposed to light and/or air. ARS scientists have moved closer to solving this problem by replacing the aldehyde components with environmentally safe chemical "mimics" called analogs. Analog-bolstered attractants demonstrated excellent stability when exposed to light and air in a 13-day field test. Additionally, lures with analog-based attractants proved as attractive to weevils as the attractants with natural aldehyde components: 101 weevils captured in traps compared to 102, respectively. More research is needed on the neurological and behavioral responses of weevils and other pests to available analogs, before new ones are discovered for use in commercial attractants.

*Boll Weevil Research, Mississippi State, MS*

*Joseph C. Dickens, (601) 323-2230*



A synthetic copy of a natural chemical produced by a date-devouring beetle is being tested for its ability to attract this pest in Southern California. The beetle, *Carpophilus mutilatus*, is believed to normally destroy about 10 percent of deglet noor dates, and claimed a much greater share of 1991's bigger and more expensive medjool dates. Individual traps baited with the chemical, called a pheromone, captured up to 30,000 of the beetles in a single day. In the future, bait stations holding only a small amount of insecticide and the pheromone may attract large numbers of the pests, also known as "confused sap beetles," without the need to apply insecticide to the whole crop. Sap beetles are found throughout the world and spread fruit-degrading fungi in a wide variety of crops besides dates, including figs, peaches, plums, pineapples and corn.

*Bioactive Constituents Research, Peoria, IL*  
Robert J. Bartelt, (309) 685-4011

A new species of North American fruit fly has been discovered in central Mexico that breeds in and destroys wild currants. Many of the true fruit flies like the Mediterranean fruit fly and apple maggot are major pests worldwide. Named *Euphranta mexicana*, the pest is the second species of its type to be found on this continent. It is a potential pest of currants in the U.S. and Canada, as is *E. canadensis*. Last year, the U.S. produced about 4,000 tons of currants, which are used in baked goods, and have a market value of about \$7.25 million. ARS scientists have developed descriptions and illustrations of the new fruit fly to help regulatory agencies like USDA's Animal and Plant Health Inspection Service distinguish the two species from other pests and prevent them from entering the U.S.

*Systematic Entomology Laboratory, Washington, DC*  
Allen Norrbom, (202) 382-1795

## Crop Production and Protection

Keeping grapes free of unwanted sulfite residues should be easier and less costly, thanks to an idea from an ARS scientist. Slender glass tubes, resembling small thermometers, can be used to monitor how much sulfite-producing sulfur dioxide—a fumigant—reaches grapes in cold storage. Packers and shippers can position tubes in some of the hundreds of boxes of grapes stacked in storage rooms. The fumigant collects in the tubes. That simplifies tracking of the chemical as it circulates through the cold room. Because some consumers are allergic to sulfites, federal law stipulates that residues on grapes must not exceed 10 parts per million. But without fumigation, grapes could be stored for only about three weeks before succumbing to *Botrytis* rot, a gray mold. The sulfur dioxide protects grapes for up to five months. That allows California grapes to be marketed as late as December. The glass tubes, sold by lab

supply companies for about \$4 each, are less expensive than other options for monitoring sulfur dioxide. The idea is one spin-off of a three-year study by ARS, the University of California and the grape industry to ensure worker and consumer safety, cut costs and limit escape of the fumigant into the environment.

*Horticultural Crops Research Laboratory, Fresno, CA*  
Joseph L. Smilanick, (209) 453-3084

By tracing grain sorghum back to its ancestral roots in Africa, ARS scientists are helping develop varieties tolerant of acid soils. Traditionally, grain sorghum has not been grown on highly acid soils common in the eastern United States because sorghum is usually extremely sensitive to such soils. In cooperation with the University of Georgia and international breeding programs in Brazil and Colombia, a search of about 10,000 types of sorghum from the World Collection of Sorghum—in Griffin, GA—produced numerous tolerant types. Breeders are crossing the tolerant sorghum—all from Africa—with U.S. plants. So far, eight tolerant types have been released to U.S. seed companies and at least one breeding line to companies in South America. ARS researchers are also looking for acid-tolerant types for other crops, including millet and pasture grasses.

*Appalachian Soil and Water Conservation Research, Beckley, WV*  
Ralph Clark, (304) 252-6426

A new soybean breeding line may help plant breeders develop soybean cultivars resistant to Race 2 soybean cyst nematodes. Races of this serious pest can reduce soybean yields by 20 to 50 percent. The new line, called J87-233, also shows high resistance to Race 1, 3, and 5 nematodes as well as root knot nematodes. In a nematode-free test in 1989, J87-233 produced 32.4 bushels of beans per acre, compared with 30.4 bushels for Bedford, an established soybean cultivar. J87-233 was released so soybean breeders can cross it with higher-yielding commercial cultivar. Samples containing 50 seeds are available upon request. Race 2 nematodes predominantly infest fields in Virginia and North Carolina, but traces of the pest have been found in Maryland and Tennessee.

*Nematology Research Lab, Jackson, TN*  
Lawrence D. Young, (901) 425-4741

Crops such as cotton or corn would be first to benefit from moss genes that give drought tolerance a whole new meaning. Lawn and pasture grasses that survive desert-style drought would be next to benefit from star moss (*Tortula ruralis*). With the addition of a few drops of water, this moss can change from a rusty Brillo pad brown to lush green individual branches with star-like needles. ARS researchers have isolated 74 proteins thought to be



involved in the repair process because they increase in numbers as the moss is drying out and within two hours of wetting it. Researchers are now closing in on the gene or genes that make the repair proteins.

*Plant Stress and Water Conservation Research,  
Lubbock, TX  
Mel Oliver, (806) 746-5353*

**Tropical corn can save money** for Sunbelt farmers who grow corn for animal feed. It reduces the need for insecticides, fertilizer and irrigation. ARS scientists have been testing two commercial varieties for the past few years in consultation with farmers and seed companies such as Pioneer Hi-Bred International. Pioneer has recently begun marketing a new tropical hybrid and more are expected on the market. The tests showed that the tight husk wrapped around the corn kernels discourages insects. Also, the corn makes peak yields on less water. Its yields match those of regular field corn as long as fertilizer rates don't exceed 150 pounds per acre. Most importantly, the corn can be planted from mid May to June 1, instead of the usual March or April dates in the Sunbelt. This lets winter cover crops reseed before they are killed by herbicides at corn planting time. Not having to replant legume cover crops each year should encourage their use. In this study, such green manure crops have reduced fertilizer use from 150 to 45 pounds an acre.

*Soil Dynamics Research Laboratory, Auburn, AL  
D. Wayne Reeves, (205) 844-3996*

**A new bermudagrass that produces more hay** and significantly increases cattle weight gains is expected to be available to southern farmers next year. The new grass, Tifton 85, withstands drought and produced an average of 26 percent more forage than a leading bermudagrass called Coastal during 1985-91 field studies. Tifton 85 is also 11 percent higher in what is called in-vitro dry matter digestibility, which uses lab test tubes and fluid from a cow's rumen to simulate normal digestion. The advantages of Tifton 85 mean faster weight gains for cattle and cost savings for farmers. Researchers found that the weight of steers grazing on Tifton 85 increased by 47 percent per acre compared to Tifton 78, another highly productive bermudagrass, during a three-year grazing study. Tifton 85 is suitable for pasture or hay. It's a hybrid between a variety from South Africa and another called Tifton 68. The new variety is taller, has larger stems, broader leaves and darker green color than its predecessors. It also suffered no apparent losses in Georgia field tests during one of that state's worst droughts in 1990. Scientists say the grass has great potential across the southern United States, where bermudagrasses are now grown on 10 to 12 million acres. Tifton 85, released by ARS and the University of Georgia, will be available from certified growers on a limited basis

in 1993.

*Forage and Turf Research, Tifton, GA  
Glenn W. Burton, (912) 386-3353*

**A tree from China could become a landscaping prize** since it fixes its own nitrogen in soil around the roots. The ability to fix nitrogen—widely studied in soybeans and other leguminous crops—is largely unexplored in trees. But in a 1989-91 study, ARS and University of Maryland scientists found that *Maackia amurensis*—a native of Manchuria that has no common name—can form nodules on its roots. These nodules are home to bacteria, called rhizobia, that take nitrogen gas from the air and chemically convert it to a form the tree can use for growth. Bacteria living on *M. amurensis* roots are of a genus called *Bradyrhizobium*. As a landscape tree, the tree wouldn't require as much fertilizer—meaning less potential runoff into water supplies. Another advantage: the tree grows slowly so its roots are less likely to break sidewalks and clog underground sewer lines. A commercial nursery is studying ways of producing the tree. It has been grown on a very limited basis in this country—including Buffalo, N.Y., where 50 were planted in the early 1960s.

*Soybean and Alfalfa Research Lab, Beltsville, MD  
Peter B. van Berkum, (301) 504-7280*

**Banana profits jumped by \$1,350 an acre** in Puerto Rico after the developing fruit was covered with bags. Tying the bags around banana bunches stops tiny mites from damaging the fruit surface, and creates a constant temperature so fruit reaches the mature green stage one to two weeks faster. A 40-month field study showed that insecticide-treated or perforated polyethylene bags increased production by 9,407 pounds per acre—a seven percent increase—during the study conducted by ARS and University of Puerto Rico scientists. By improving fruit quality, growers in Puerto Rico could boost sales to the United States, which currently imports most of its bananas from Costa Rica, Honduras and Ecuador. Puerto Rico produces an estimated 93,500 tons of bananas each year with a farm gate value of \$9 million.

*Tropical Agriculture Research Station, Mayaguez, PR  
Heber Irizarry, (809) 831-3435*

**Ryegrass and tall fescue grasses** that are highly resistant to stem rust could save U.S. grass seed growers millions of dollars in fungicides and lost yield. ARS scientists screened more than 200 plants of 26 different cultivars and found several dozen plants that ward off stem rust—one of the worst diseases of perennial ryegrass and tall fescue. Next, they will use resistant plants to breed strains that seed companies can cross with their own varieties. Stem rust can slash seed yields as much as 45 percent, so U.S. grass seed growers typically spray anti-rust fungicides three times a



year, collectively spending about \$2 million each time they spray. Both grasses are used in neighborhood parks, golf courses and sport stadiums. They also provide forage for sheep and dairy cattle. Last year, the perennial ryegrass seed crop from Oregon, the leading U.S. producer, was valued at over \$54 million.

*Forage Seed and Cereal Research, Corvallis, OR*  
*Ron E. Welty, (503) 750-8732*

**Coaxing grass seed to sprout faster** could give ranchers a head start on the aggressive weed, cheatgrass. With a technique called seed matric priming, ARS scientists cut sprouting times in half for thickspike wheatgrass, sheep fescue and bluebunch wheatgrass. Federal agencies could use the technique to reseed U.S. rangelands with these grasses, which supply forage for cattle, sheep and wildlife such as mule deer and pronghorn antelope. The method primes seeds to sprout by "plumping" them with extra moisture. The seeds get enough water to begin metabolizing starches for growth, but not enough to send out roots. Once planted, however, the quick-sprouting seeds have a better chance of outcompeting cheatgrass. That may also help prevent rangeland wildfires during the summer because the grasses stay green longer than cheatgrass. This weed dries to a fine-textured straw—perfect fuel for midsummer fires. Large-scale tests of the priming technique are planned, including recently burned range areas.

*Watershed Management Research, Boise, ID*  
*Stuart Hardegree, (208) 334-1363*

**White lupin—a grain-producing legume**—could become the first profitable winter cover crop for the South. In four years of studies, the ARS-developed Tiftwhite-78 variety has yielded up to 60 bushels of grain per acre and added 90 to 120 pounds of nitrogen per acre to the soil. Southern farmers could make money on the cash crop, using little fertilizer while they protect bare soil from erosion over winter. In the North, where white lupin is grown in the spring, its grain is valued at 75 percent of the price of soybeans, a high-ticket crop. Used mainly for animal feed, the grain is also an ingredient in high-protein, high-fiber pasta sold as a health food. Lupin is tolerant to infertile, acid, sandy soils and is suited to much of the South's Coastal Plain. In low-phosphorus soils, the crop's roots secrete a chemical that makes phosphorus more soluble and useable by the plant. ARS scientists are working with Auburn University scientists to further develop the potential of the crop. The research is partly funded by the Alabama Farmers Federation.

*Soil Dynamics Research Laboratory, Auburn, AL*  
*D. Wayne Reeves, (205) 887-4515*

**Metalaxyl, the major fungicide** used to control late blight, failed to protect tomatoes and potatoes in Pacific Northwest tests. Late blight is caused by the fungus *Phytophthora infestans*. Metalaxyl was introduced in the late 1970's and is now used by growers worldwide to combat mildews and *Phytophthora* diseases on various crops. But questions arose in 1989 and 1990 when late blight severely damaged home-garden tomatoes and commercial potato fields in northwestern Washington that had been treated with the fungicide. And in 1991, metalaxyl-treated potato fields in British Columbia, Canada, showed significant blight damage. Scientists from ARS, Washington State University and the British Columbia Ministry of Agriculture, Fisheries and Food cooperated in the study. Research on the action of metalaxyl on these crops is continuing.

*Vegetable Laboratory, Beltsville, MD*  
*Kenneth L. Deahl, (301) 504-5216*

**Five new high-yielding, disease-resistant snap bean** germplasm lines have been released to commercial plant breeders to develop new varieties for the market. The lines, known as BelJersey-Rust Resistant -13, -14, -15, -16 and -17, were released by ARS and the New Jersey Agricultural Experiment Station. The lines are resistant to 58 identified races of the bean rust fungus, *Uromyces appendiculatus*. Severe occurrences of this rust can cost bean growers as much as \$250 million in losses annually. The BelJersey lines derive their rust-resistance from two bean varieties first introduced into the U.S. from Latin America in the 1940s. The Latin American beans were crossed with several commercial cultivars to develop germplasm lines for tender, stringless pods, high yield, and resistance to both bean rust and common mosaic virus.

*Microbiology and Plant Pathology Laboratory, Beltsville, MD*  
*J. Rennie Stavelly, (301) 504-6600*

**Corn-cotton rotations can provide cotton growers with an alternative weapon** against harmful nematodes. Reniform nematodes can reduce yields of cotton grown in Gulf Coast states by 40 to 60 percent by attacking plant roots. As chemical controls for nematodes dwindle, scientists with ARS and the Extension Service in Mississippi studied 50 corn hybrids that could help farmers combat this pest. Greenhouse studies indicated nematodes were unable to feed or reproduce in corn roots. When cotton followed corn in the soil, only 400 nematodes per pint of soil remained, compared with 15,000 per pint when cotton was grown alone.

*Corn Host Resistance Research, Mississippi State, MS*  
*Gary L. Windham, (601) 323-2230*



Two herbicides, trifluralin and metolachlor, kill weeds in kenaf fields without hurting the crop's yields, ARS studies have shown. Kenaf is an increasingly popular crop because the entire plant can be used as a source of fiber for livestock feed, twine, paper and compost chips. Scientists found that when fields are sprayed with trifluralin or metolachlor before kenaf is planted, up to 90 percent of weeds are killed. Applying either of the herbicides at rates of one-half, one or two pounds of active ingredients per acre controlled weeds without reducing kenaf yields. Based on the ARS and state university findings, the Environmental Protection Agency approved trifluralin for use with kenaf on February 4, 1992. EPA approval of metolachlor for use with kenaf is still pending.

*Genetics and Production Research, Lane, OK*  
Charles L. Webber III, (405) 889-7395

Inserted genes stand a better chance of securing a berth in corn cells if the cells are conditioned in a sugary solution beforehand. "Borrowed" genes could give plants new or improved resistance to crop pests and diseases. Foreign genetic material can be inserted in corn cells by bombarding the cells with tungsten particles that carry the new genes. But the corn cells can be damaged by these bombardments, affecting the extent to which the new genes are taken into the corn cells. Researchers with ARS and the Ohio Agricultural Research and Development Center at Wooster preconditioned the corn cells on a medium containing two sugars—sorbitol and mannitol. The conditioning apparently made the cells more resilient to damage from the tungsten particle bombardments. Six weeks after bombardment, the scientists found that six to seven times more preconditioned cells had taken in the foreign genes than did cells that weren't treated with the sugary solution.

*Corn and Soybean Research, Wooster, OH*  
Michael D. McMullen, (216) 263-3894

Apple growers may soon have an environmentally friendly chemical to help them harvest an abundant crop each year. Apple trees naturally produce a huge crop one year and a small one the next. To keep production steady from year to year, orchardists currently remove more than half of their trees' blossoms by spraying chemicals that damage the flowers. Such thinning yields larger apples—and spares the tree enough energy to make blossoms the next season. One widely used chemical thinner, Elgetol, was recently taken off the market. But an ARS scientist found that a different chemical—already approved for other crops—will likely provide a safe and effective replacement. The scientist tested very low levels of the compound, sulcarbamide, on four different apple varieties over several growing seasons with excellent results. The chemical breaks down within 24 hours into urea and sulfate, which the trees actually use as nutrients. Results from a test on 200 acres of apples

conducted last spring provided data to support its use in apple orchards. The compound will be available to growers for use on a limited basis in 1993.

*Physiology and Pathology of Tree Fruits Research, Wenatchee, WA*  
Max W. Williams, (509) 664-2280

Descendants of crested wheatgrass from Iran and Turkey could allow U.S. homeowners to enjoy their lawns more and mow and water them less. Over a 10-year period, ARS scientists identified, bred and evaluated several lawn-type strains of crested wheatgrass, *Agropyron cristatum*. These strains could be forerunners of new commercial lawn varieties in about five years. Although crested wheatgrass typically grows in bunches, the new grasses have extensive underground stems, known as rhizomes, so they form a sod like a lawn. The new strains grow slowly, so a lawn could be mowed less often and would require only about a third as much water. They fend off common root-nibbling pests such as sod webworms and billbugs. The new grasses even offer a soft cushion for backyard lounging—their fine to medium size blades aren't sharp or prickly like those of coarser lawn grasses. Crested wheatgrass grows on temperate rangelands throughout the world and is an important food for grazing cattle, sheep, deer and elk. In the U.S., crested wheatgrass lawns would likely grow best in the Pacific Northwest, Intermountain West and Great Plains. Researchers are expanding tests of the new lawn grasses. Besides home lawns, the grasses have potential for parks, golf fairways and roadsides.

*Forage and Range Research, Logan, UT*  
Kay H. Asay, (801) 750-3069

Vegetable crops are thriving under irrigation from waste water used to raise cold-water fish. Scientists harvested lettuce and strawberries from hydroponically grown plants fertilized with rainbow trout effluent. Quality was as good as that from conventionally grown plants. Plants treated with the rainbow trout effluent turned yellow, but an addition of iron corrected the problem. The effluent is deficient in iron, an element that fish don't need in high amounts. An added benefit of this system is a plant-based waste water treatment system to alleviate pollution generated by aquaculture facilities.

*Appalachian Fruit Research Station, Kearneysville, WV*  
Fumiomi Takeda, (304) 725-3451

A waste by-product from the coal industry applied to apple orchards 11 years ago significantly raised pH and calcium levels in the soil and increased tree yields. Bottom ash is a dry, alkaline waste that is high in acid neutralizers and gypsum. ARS researchers applied 50 tons of ash per acre to study its effect on soil over time. PH increases were found down to a depth of 14 feet. Yield increases varied during the 11-year experimental period, depending on the



apple variety, but were significantly higher on Spuree Rome. Fruit showed no nutritional problems from the ash. The coal industry generates over 90 million tons of the waste annually, most of which must be disposed of in landfills. Stockpiles of ash may increase due to mandates of the new Clean Air Act.

*Fruit Lab, Beltsville, MD*

*Ronald F. Korcak, (301) 504-5650*

**Several sweet and juicy Japanese plum varieties** will be released soon to growers. Developed from a Japanese plum bred with various American species, the new plums are being grown in test plantings in 11 southern states. These plums are far superior to commercially available southeastern varieties in size, eating quality and disease resistance. Well suited for farmers seeking alternative income-producing crops in the southeastern United States, the new introductions are ideal for home gardeners.

*Southeastern Fruit and Tree Nut Research Lab,*

*Byron, GA*

*William R. Okie, (912) 956-5656*

**Oat plants have been genetically engineered** for the first time, raising hopes that someday the plants may be redesigned to better resist diseases and produce more nutritious grain. ARS and University of Minnesota scientists bombarded oat embryo tissue culture with tiny tungsten particles coated with foreign DNA. The foreign DNA, used for experimental purposes only, included genes to produce an enzyme that allowed some oat tissue culture cells to resist an antibiotic. Also in the DNA were genes to produce another enzyme that made cells turn blue when treated with a test chemical. Scientists subsequently confirmed the genes were present in seeds of plants grown from the tissue culture and in those plants' offspring.

*Plant Science Research, St. Paul, MN*

*Howard W. Rines, (612) 625-5220*

## Scientific Information Systems

**Wheat growers may reap healthier harvests** for less money with help from a computer program called MoreCrop. Developed by ARS, the user-friendly program prompts a grower to enter information such as the wheat variety being grown, the tillage method used and the weather conditions. Then the program predicts which diseases are most likely to threaten that crop. At the touch of a few buttons, the grower also gets an on-screen description of why a selected disease—stripe rust, for example—may or may not occur. Growers can then get on-screen advice about types, amounts and timing of chemical applications as well as when crop protection chemicals aren't necessary. They also can tap into MoreCrop's library—with information such as disease-resistant culti-

vars, maps of geographical regions and a glossary. Thirty years of data on causes and controls of rusts, smuts and other wheat diseases enabled researchers to construct the program. It runs on IBM or compatible computers, and requires version 3.0 or higher of Microsoft Windows. The program will soon be available through county extension agents for a small fee.

*Wheat Genetics, Quality and Physiology Research,*

*Pullman, WA*

*Roland Line, (509) 335-3755*

**A video camera provides scientists** with a quick, accurate method to screen for a sugarcane disease. Ratoon stunting disease (RSD), caused by a pathogen inside the plant, retards maturity of sugarcane in Florida. Normally, scientists screen for RSD susceptibility in a sugarcane cultivar by counting blue stains left by an assay for the pathogen when infected plant tissue is pressed against a thin membrane. But that method is time-consuming. A new technique, adapted for sugarcane by ARS scientists and the Florida Sugar Cane League, is DIAS—the Digital Image Analysis System. A video camera photographs the dots and then feeds the image into specially-designed computer software for counting. In tests, DIAS checked 1,200 to 1,350 tissue samples in the time it takes to visually check 450 to 600. DIAS will allow scientists to rapidly determine which cultivars are too susceptible to RSD for commercial production, and which ones offer resistance that could be bred into future sugarcane varieties.

*Sugarcane Production Research, Canal Point, FL*

*Jack C. Comstock, (407) 924-5227*

**A computer program accurately predicts** when weeds, corn or soybean plants will sprout when planted at various depths in either dry or moist soil. ARS scientists believe the program can be used as part of a larger computer model that would use information about plant biology and economics to help farmers decide the best course of action to control weeds. Laboratory tests subjected seeds to an array of soil temperatures and water contents. Germination and seedling growth rates were measured and the data from the lab tests was used to write the computer program.

*Crop Protection Research, Urbana, IL*

*David Alm, (217) 244-0118*

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# Quarterly Report

of Selected Research Projects October 1 to December 31, 1992

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

### Patent Licenses

...To Dole Associates of Katonah, NY, to commercialize an ARS-developed test that detects harmful strains of *Y. enterocolitica* without killing them. Dole Associates obtained limited rights to market the technology, which is available to other companies. The test enables scientists to recover the live bacterium from food and water, compared with current tests that kill the bacterium. This test is important when initial results of field tests need to be confirmed. The Food and Drug Administration recently used the technology to detect harmful strains of the pathogen in Los Angeles County. USDA's Food Safety and Inspection Service is training personnel on how to use the test. Bacteria samples can be collected from food, food processing equipment, and water and sewer treatment facilities, then grown in the lab for identification and verification. *Y. enterocolitica*, which can cause food poisoning, can grow at refrigerator temperatures, but the genes that mark it as a disease-causing strain are expressed

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, Bldg. 419, BARC-East, Beltsville, MD 20705, (301) 504-9108 or 504-8916.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.

only at body temperature. So, all tests require incubation at 98.6 degrees F to detect harmful strains. Incubation takes just 12 hours. Longer incubation causes the organism to lose its disease-causing genes and make it appear to be a harmless strain. (PATENT APPLICATION 07/493/662)

ARS Contact: Saumya Bhaduri, Microbial Food Safety Research, Philadelphia, PA, (215) 233-6521

...To Crop Genetics International of Hanover, MD, to use fungi and sex attractants as new, nature-based commercial controls for soybean cyst nematodes. By sucking on soybean roots, the wormlike pests stole \$250 million in soybean yields from U.S. growers in 1991. But ARS scientists invented two strategies that could give farmers safe, effective options to chemical nematicides, some of which have been banned as environmental hazards. One new control is a mutant strain of *Verticillium lecanii* fungus that destroys more nematode eggs than strains found in nature. Another strategy prevents nematodes from mating—the males get sidetracked by compounds that mimic females' sex attractant, or pheromone. Joint use of fungi and a pheromone-like compound—released from pellets placed in the soil—cut nematode numbers as much as 86 percent in field tests. ARS is running tests under a cooperative research and development agreement with the company. (PATENT APPLICATIONS 07/633,815 and 07/645,438)

ARS Contact: Susan L.F. Meyer, Nematology Laboratory, Beltsville, MD, (301) 504-5660

...To NeutraTherm Inc. of Des Moines, IA, and Phenix Co. of Tokyo, for a textile-coating process, known as "polytherm," which makes fabrics respond to changes in temperature. ARS scientists invented the technology that binds to fibers a class of chemicals called PEGs (short for polyethylene glycols). PEGs make the fabric absorb and store heat when the temperature rises and release it when the temperature drops. Treated fabrics also have many other improved properties such as high water absorbency, excellent soil release, durable press wear, resistance to static charge and pilling (balls of lint), and suppression of bacteria, fungi and body odors. NeutraTherm supplied T-shirts to the U.S. Olympic ski team and thermal underwear to the Professional Ski Instructors of America. Phenix is currently selling skiwear and gloves in Japan with projected first year sales of about \$20 million. Other companies are in different stages of licensing the technology for biomedical, health care and veterinary uses. Also, the National

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Aeronautics and Space Administration and its contractors are evaluating the suitability of treating fabrics for spacesuits and other possible aerospace uses. (PATENT 4,851,291)

ARS contact: Tyrone Vigo, Southern Regional Research Center, New Orleans, LA, (504) 286-4487

## Cooperative Research and Development Agreements

...With Plato Industries, Inc. of Houston, TX, to improve a "bait stick" for commercial control of the cotton boll weevil. A sex attractant combined with a feeding stimulant on wooden or plastic sticks helps kill weevils by luring them onto a coating of insecticide. Developed and patented by ARS scientists, the sticks killed up to 70 percent of weevils in field tests with cotton. Amid concern over environmental safety, the sticks could mean a new way to protect groundwater because they use less insecticide per acre than spray applications. The bait sticks—which have little or no effect on beneficial insects—could help reduce the \$300-million-plus cost in cotton losses and control measures incurred each year. (PATENT APPLICATIONS 07/592,946 and 07/885,052)

ARS contact: Gerald H. McKibben, Boll Weevil Research, Mississippi State, MS, (601) 323-2230

...With Gentra Systems, Inc. of Minneapolis, MN, for developing molecular probes to seek out and bind to genes that play a role in disease resistance of chickens. These genes are known as the major histocompatibility complex (MHC). Chickens have a wide variety of MHC genes, some of which exhibit better immune responses following vaccination. A few laboratories do blood typing to identify some of these genes, but only in egg-laying strains of White Leghorns. This blood typing technology has not been extended to the broiler or turkey industry. Molecular probes to identify the predominant MHC genes in all breeds of poultry will allow poultry breeders to pinpoint the MHC genes responsible for the best disease resistance.

ARS contact: Larry D. Bacon, Avian Disease and Oncology Laboratory, East Lansing, MI, (517) 337-6831

...With CCT Corp. of Litchfield Park, AZ, to develop inexpensive granular formulations of *Bacillus thuringiensis* (Bt) using feeding stimulants for better control of European corn borers. Bt is a naturally-occurring bacteria used to kill many insect pests of agricultural crops. Commercial formulations with Bt provide inadequate control of the corn borer because the pest often doesn't find the granules appetizing. But ARS scientists are using feeding stimulants to make the granules more appealing to corn borers, thus allowing Bt to better control them.

ARS Contact: Richard L. Ridgway, Insect Biocontrol Laboratory, Beltsville, MD, (301) 504-9028

...With American Cyanamid Company of Princeton, NJ, for evaluating the effect of a pour-on formulation of Moxidectin, a parasiticide, in two different uses. One is against migrating larvae of the cattle grub, *Hypoderma lineatum*; another is against egg production by trichostrongyle nematodes in the gastrointestinal tract of cattle. Cattle grubs cause annual losses of more than \$600 million in the United States in damage to hides and reduced weight gains in cattle. Moxidectin is one of several avermectins currently being developed. These products are effective against a wide range of parasites at lower doses than organophosphorus systemic insecticides. Unlike the organophosphates, these products can kill both migrating larvae and the more mature larvae. They also can be used later in the season on adult cattle. Moxidectin has also been found effective against horn flies.

ARS contact: Sidney E. Kunz, Knippling-Bushland U.S. Livestock Insects Research Laboratory, Kerrville, TX, (512) 792-0303

## Human Nutrition

Chubby young girls are not destined to become obese middle-age women, nor are skinny young girls assured of staying slim. A study of 50 years of height and weight data shows that childhood obesity in females does not predict obesity at age 40 or 50 as it does in males. The findings do not support putting overweight young girls on diets to prevent obesity later in life, says the study leader. Females go through many body changes starting at puberty when they have a marked increase in body fat. Some may thin out due to their adolescent growth spurt, while others may begin a history of dieting at this time. Researchers analyzed height and weight measurements of 91 men and women in the Harvard Longitudinal Studies of Child Health and Development and found no correlation between females' body mass index (BMI) at age five to seven years and at middle age. BMIs—weight divided by height squared—in early adolescence were good predictors of their relative weights at age 40. But not until the young women reached 18 did their BMIs correlate well with those at age 50. By contrast, the males' BMIs at all ages—childhood, adolescence and young adulthood—were more reliable in predicting body size in middle age.

Human Nutrition Research Center on Aging at Tufts, Boston, MA

Virginia A. Casey (formerly with ARS), (617) 727-6436

An overweight teenage male has twice the risk of dying earlier than a lean male. And overweight teenagers of both sexes have a higher risk of serious disease before age 73. These risks don't depend on one's weight in middle age, according to a recent follow-up study of 508 men and women who participated in the 1922-35 Harvard Growth



Study from first grade through high school. Those in the top 25 percent for weight in their teens were twice as likely to have been diagnosed with coronary heart disease, seven times more likely to have atherosclerosis, and nearly three times more likely to have gout by age 73 than their leaner peers. Excess teenage weight also increased the risk of colorectal cancer in men by six times and doubled the risk of arthritis in women. The researchers interviewed those Harvard study participants who were still living and could be reached after 55 years, and obtained dates and causes of death for the deceased. They also used height and weight data from a mid-life follow-up in their analysis to see if it influenced risk. Middle-age weight status did not change risk significantly. This doesn't mean that middle-aged people can ignore excess weight; it's still an important risk factor. But the study emphasizes that successful treatment of excess weight in adolescence may prevent a significant proportion of adult disease and death attributed to obesity.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Aviva Must, (617) 556-3325*

*Floating Hospital, New England Medical Center,  
Boston, MA*

*William H. Dietz, (617) 956-0132*

**A group of obese young women** averaged a two- to three-percent loss of bone during a controlled, five-month weight loss study, even though they exercised regularly and got ample dietary calcium. Also, biochemical tests showed that the women had a higher rate of bone breakdown and a lower rate of bone formation during the three months their calorie intake was cut in half. Obese women generally are thought to have a lower risk of osteoporosis than lean women because of a larger bone mass. But that margin of risk narrowed in this study—the first to look at the consequences of weight loss on bone mass. The findings have implications for people who lose and gain weight in a yo-yo fashion. If they don't regain the lost bone each time they regain weight, they could be at higher risk for osteoporosis than previously thought.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND*

*Henry C. Lukaski, (701) 795-8429*

**Excess body fat appears to build up** from too little physical activity rather than too many calories, researchers concluded. In studies of two groups of sedentary men—one group in their 20s and another over 65—there was no relationship between the men's body fat levels and their calorie intake. There was, however, a significant inverse relationship with physical activity: Those who engaged in the least physical activity had the most fat. Both groups ate significantly more calories each day than currently recommended and burned significantly more. These findings support evidence that the current Recommended Dietary

Allowances for energy (calories) significantly underestimate actual requirements. The older men, for instance, burned an average 2,800 calories daily compared to the 2,400-calorie RDA. That's because their physical activity was significantly higher than the value used to calculate the RDA even though they did not exercise on a regular basis. The new data will help health professionals reassess the adequacy of food intake for different populations and also allow USDA to fine-tune its food aid based on how many calories individuals actually eat. The data also provide a more accurate basis for setting weight reduction diets. The 1,500-calorie diet typically recommended for men is a bigger cut in calories than previously thought. A better prescription for fat loss would be to move around more throughout the day.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Susan B. Roberts, (617) 556-3238*

**Blood lipid abnormalities were found** in more than half the families of coronary artery disease patients under age 60. The study of 102 families emphasizes the need to screen all blood relatives, especially children, of premature coronary artery disease patients. Low HDL cholesterol—the good kind—was the most common abnormality. One out of three families had HDL in the lowest 10 percent, indicating that its absence is a prime risk factor for heart attack. Most of these low-HDL families also had either high triglycerides or high triglycerides and high LDL cholesterol, the bad kind. One out of five families had an excess of Lp(a)—another lipid-carrying particle that is gaining attention as a risk factor for heart disease. It was the only lipid abnormality in more than half of the cases. Very few families—one out of 20—had high triglycerides or high LDL alone. The findings underscore the need for physicians to focus more attention on treating people with low HDL and other lipid changes instead of targeting high LDL symptoms.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Ernst J. Schaefer, (617) 556-3100*

*Jacques J. Genest (now in Montreal), (514) 987-5715*

**Eating more carbohydrates did not improve** the endurance or strength of men who exercise moderately—unlike the payoffs for marathoners and other athletes who train long and hard. Eighteen men in their 20s and 30s were tested after eating both high and low carbohydrate diets. A third of the men were sedentary. The other two groups either ran (aerobic exercise) or lifted weights (strength training) three to four times a week for an hour or less. After three weeks of getting 62 percent of their calories as carbohydrates, none of the volunteers could pedal a stationary bicycle significantly longer than when they got 42 percent carbohydrates. Nor could their leg muscles



overcome any more resistance or their upper bodies bench-press any more weight. Both runners and weight lifters burned significantly more calories per day than the sedentary group. The runners averaged 14 percent more calories daily; the weight-lifters, who trained the hardest, averaged 21 percent more. The findings underscore that people who exercise regularly can eat more calories than sedentary people and still maintain a healthy weight. On the other hand, eating more carbohydrates probably won't improve performance during such exercise. But it cuts down on fat intake, and that's beneficial for everyone.

*Energy and Protein Nutrition Laboratory, Beltsville, MD  
Joan M. Conway/James L. Seale, (301) 504-8977/8127  
Northern Arizona University, Flagstaff, AZ  
Scott VanZant, (602) 523-4020*

**Copper deficiency explains why people** who regularly use zinc supplements have a drop in the "good" HDL cholesterol. Pigs exposed to excessively high zinc during gestation and afterwards had a mild copper deficiency even though they and their mothers got adequate copper throughout the study. In several studies, copper deficiency has produced adverse cholesterol changes in people and animals. And it's well known that excess zinc interferes with copper metabolism and vice versa because the two metals are similar in their chemical properties. So researchers wanted to test whether the drop in HDL cholesterol that was attributed to high zinc was actually due to copper deficiency induced by high zinc. They used pigs because their circulatory and digestive systems are similar to those of humans. The result: Animals exposed to excessive zinc—about 33 times normal—had lower HDL cholesterol and less copper in the blood and heart muscle than the controls. Moreover, heart muscle tissue showed the same abnormalities under the electron microscope as animals fed a copper-deficient diet. Unlike these pigs, most people eating diets of Western countries don't get the recommended amount of copper. So indiscriminate use of zinc supplements should be discouraged because of the potential for cardiovascular harm.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Leslie M. Klevay, (701) 795-8464  
Children's Nutrition Research Center, Houston, TX  
Wilson G. Pond, (713) 798-7000*

**More evidence that the immune system** depends on an adequate intake of copper to operate at peak performance comes from a study of T cells from rats. The new study shows that T cells—lymphocytes that orchestrate the cellular response to invading organisms—need this essential trace element to respond optimally. Researchers compared T cells from the spleen of rats raised on copper-deficient diets with those from a control group that were fed ample copper. When activated with standard antigens, T cells

from the copper-deficient rats had a markedly lower degree of DNA synthesis, which is necessary for cell division. Addition of copper to the copper-deficient T cells enhanced DNA synthesis by increasing the cells' secretion of interleukin-2, which is required for T cell division.

*Vitamin and Mineral Nutrition Laboratory,  
Beltsville, MD  
Mark L. Failla (formerly ARS), (919) 334-5313  
Food and Drug Administration, Rockville, MD  
Shukal Bala, (301) 227-6247*

**Beta carotene's reputation for preventing cancer** may be due partly to the body's ability to convert it into retinoic acid. This vitamin A relative is being successfully used in cancer treatment programs here and abroad. But it's quite toxic to tissues, so the body breaks it down quickly. Now, studies of cultured human and animal cells and of ferrets—which metabolize beta carotene much the same as people do—show that intestinal cells themselves convert a small portion of beta carotene into retinoic acid and other vitamin A-related compounds. These compounds are absorbed by the cells and move into circulation slowly to prevent toxic levels. The studies also found that lung, liver, kidney and fat tissues can convert beta carotene into retinoic acid and its relatives. This suggests that we can raise levels of retinoic acid in body fluids or tissues by eating more foods high in beta carotene, which is not toxic even in fairly large doses. Orange and yellow fruits and vegetables and dark green leafy vegetables are rich in beta carotene and other carotenoids.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Xiang-Dong Wang, (617) 556-3313*

## Animal Production and Protection

**A sow's milk can be analyzed** to pinpoint pigs with resistance to disease-causing K88 *Escherichia coli* bacteria. Currently, the only way to identify K88-resistant pigs is by post-mortem examination of intestinal cells. Intestinal diseases cost the U.S. pork industry about \$85 million a year. ARS researchers developed the milk test during studies on imported Chinese hogs to look for resistance to K88, which causes diarrhea in newborn and baby pigs. Identifying resistant pigs is the first step toward developing a breeding line that could be used to incorporate the trait into U.S. breeds.

*Physiopathology Research, Ames, IA  
Rita D. Michaels/Shannon C. Whipp, (515) 239-8242*

**A bacterium that causes deadly pneumonia** in swine could also provide protection against the same pneumonia. In tests, ARS scientists experimentally vaccinated pneumonia-free pigs twice with a crude toxin from the bacterium



*Actinobacillus pleuropneumoniae*. Other pigs were vaccinated twice with one of four commercial vaccines, while others received no vaccination. All the pigs then were given *Actinobacillus* bacteria, resulting in pneumonia. Half of the pigs that were unvaccinated or received the commercial vaccines died. None of the pigs vaccinated with the concentrated toxin died. Also, the toxin-vaccinated pigs showed fewer symptoms such as depression, sneezing, coughing and vomiting. *Actinobacillus*-caused pneumonia is increasing in U.S. swine herds raised in confinement, and can spread in as little as eight hours after an infected pig is introduced into a herd.

*Physiopathology Research, Ames, IA*  
Paula J. Cray, (515) 239-8672

**An experimental pseudorabies vaccine** containing selected genes from that virus gives pigs immunity against this costly swine disease. ARS researchers are evaluating the vaccine from Virogenetics of Troy, NY, as part of USDA's push to eradicate pseudorabies in pigs by the year 2000. Pseudorabies costs pork producers about \$60 million each year. The disease can be fatal to young pigs and causes abortions in pregnant gilts and sows. To create the vaccine, a vaccinia virus strain was modified by deleting genes that enable the virus to cause disease. With these genes deleted, the vaccinia virus strain called NYVAC has room to take in genes from several other viruses, making it a good foundation for a vaccination that protects against several diseases at once. Field trials are needed before a commercial product can be marketed.

*Virology Swine Research, Ames, IA*  
William L. Mengeling/Susan Brockmeier,  
(515) 239-8254

**For the first time, cow cells that produce** components of milk have been grown in laboratory cultures. ARS scientists say studying the cells from cow mammary glands could lead to new insights on how cows make milk, as well as new methods for stopping bacterial infections that cause mastitis. Mastitis costs U.S. dairy farmers \$2 billion annually in treatment and lost milk production. To date, the scientists have cultured cells that produce casein, lactalbumin and lactoferrin—all important "ingredients" in milk. Using cell cultures in research instead of cows is economical, and scientists can directly witness the cells' response to medications, hormones or other treatments. That's not possible in studies of live animals.

*Milk Secretion and Mastitis Laboratory, Beltsville, MD*  
Eduardo Cifrian, (301) 504-8330

**Farmers can fine-tune pregnant dairy cows' diets** to ensure healthy calves by paying close attention to mineral requirements. A cooperative study by ARS and Cornell University scientists marks the first complete mineral analysis of the dairy cow conceptus, which includes not

only the fetus, but also fetal membrane and fluids. The scientists studied fetal levels of potassium, sodium, magnesium, iron, zinc, copper, manganese, calcium and phosphorus. One finding: At day 200 of gestation, the fetus deposits about two grams of calcium and 1.3 grams of phosphorus per day. But at day 270, calcium needs have increased to about 10 grams a day, and phosphorus to nearly five grams per day. A pregnant cow absorbs about 45 percent of the calcium in her diet. This absorbed calcium is used by the cow to maintain her body and support the fetus. A 1600-pound dairy cow needs about 12 grams of calcium a day for her body alone; the finding that the fetus in late gestation needs another 10 grams a day means the pregnant cow needs to eat about 50 grams per day to produce a healthy calf.

*U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY*  
William A. House, (607) 255-4502

**Grazing on fungus-infected tall fescue grass** can cause a cow to produce less milk for her calf, but how much less depends on the breed of the cow. A three-year study compared Angus and Brahman cows that grazed on infected tall fescue versus common bermudagrass. On bermudagrass, the Angus' average milk output of 14 pounds per day topped the Brahman's 12.8 pounds. But when the cows ate fungus-infected tall fescue, the Brahman produced an average 11.6 pounds of milk per day, compared with the Angus' 10 pounds. Overall, the tall fescue's impact on Brahman milk production was much smaller at 1.2 pounds compared with the four-pound loss suffered by the Angus cows. Tall fescue, a widely used forage in the upper Mid-South, often contains a natural toxin that results from a fungus infecting the grass. This toxin can also interfere with a cow's body temperature regulation and circulatory system, but Brahman appear to be better equipped physically to deal with the toxin's effects than some other breeds of cattle.

*South Central Family Farms Research Center,  
Booneville, AR*  
Michael A. Brown, (501) 675-3834

**Field tests of rose clover** show this forage legume could become a favorite with livestock producers. In the dry Western states, many legumes can't survive summer drought, especially in pastures where they must compete against grasses for water. But rose clover provides grazing early in the growing season, produces seed and is out of the way before warm-season grasses emerge. Eighty percent of the seed it leaves behind to produce the next crop is hard seed, capable of remaining viable for years until rains provide favorable conditions for growth. Rose clover has been used in California and Oregon, but its traditional intolerance of cold kept it out of Midwestern states. However, in ARS tests in Oklahoma, lines of rose clover from Spain survived winter temperatures of minus 12



degrees F. Rose clover is not prone to cause bloat in grazing animals, and is nutritious. Despite its hairy leaves, rose clover is as readily grazed by livestock as more typical forages such as red clover or hairy vetch.

*Grazinglands Research, El Reno, OK*  
*Daniel P. Mowrey, (405) 262-5291*

Leaves from kenaf, a bamboo-like tropical plant, can rival alfalfa as a high-protein livestock feed and provide farmers with a second crop on winter wheat acres from Kansas to the South. In tests, kenaf harvested 60 to 80 days after planting in central Oklahoma yielded about three tons of dry matter per acre, including leaves and stems. The leaves contained about 30 percent crude protein, compared with 16 to 21 percent for alfalfa. When kenaf was harvested later, crude protein levels dropped, but dry matter yields climbed to almost six tons per acre at 123 days. If winter wheat is planted for grazing, researchers say, kenaf can go on the same ground in May; if the wheat is harvested for grain, kenaf planting may be delayed until late June. The wheat-kenaf rotation does well on non-irrigated land, although some sort of reduced-tillage practice probably will be necessary to ensure enough soil moisture for both crops.

*Grazinglands Research, El Reno, OK*  
*William A. Phillips, (405) 262-5291*

Coconut meal added to a lamb's diet can boost the animal's average daily weight gains. In three 60-day trials in the Virgin Islands in cooperation with the University of the Virgin Islands, St. Croix lambs ate their fill of a tropical grass called guineagrass, plus all they wanted of either the coconut meal or fish meal. In one trial, the lambs also received molasses at the rate of one percent of their body weight; in another, the animals ate the grass and molasses with various combinations of coconut meal and fish meal. The greatest increases in average daily weight gain were about five ounces per day on the guineagrass-coconut meal-molasses combination and about 4.5 ounces per day on the guineagrass plus coconut meal. Coconut meal and molasses from sugarcane would be relatively inexpensive feed additives on a regional basis in tropical or semitropical areas. Coconut meal is a byproduct from production of coconut oil.

*Subtropical Agricultural Research Station,  
Brooksville, FL*  
*Andrew C. Hammond, (904) 796-3385*

### **New and Improved Products**

**When is beef flavor at its peak?** ARS scientists say it's usually four to five days after slaughter depending on the cut of beef. That's when a muscle protein related to beefy flavor begins to naturally break down. In the first four-to-five days from slaughter, a peptide, dubbed BMP for "beefy meaty peptide," is present in beef cuts. Increased knowl-

edge of this peptide could lead to a commercial version of BMP as a food additive. The peptide not only gives meat the greatest degree of beefy flavor, but offers a valuable source of nutritional protein. Peptides and proteins are chains of amino acids. Individual amino acids have different tastes—some sweet, sour or bitter. BMP, which has eight amino acid links, loses its beefy meaty flavor and develops a bitter or sour taste, as amino acid links are removed by enzymes during aging that follows slaughter. Researchers are looking for the parent protein of BMP. Once the parent protein is identified, it may be possible to breed cattle that will produce more beefy-flavored cuts. Also, information on BMP's origin could help the meat industry understand what methods need to be used at slaughter to stimulate BMP production.

*Food Flavor Quality Research, New Orleans, LA*  
*Arthur M. Spainer, (504) 286-4470*

**Edible films, coatings and other plastic-like products** made from soy protein could extend the shelf life of fruits, vegetables, meats and packaged foods. And, the ARS development could also boost the nutritional value of food by adding extra protein and give soybean farmers a new use for the commodity. This new substitute for synthetic petroleum-based plastics also helps reduce environmental pollution. Scientists experimented with soy-protein powders to develop films, coatings and plastic-like products. The proteins can be mixed with various ingredients and additives before being cast into films or coatings for food products. And, by using enzymes and other treatments, the protein can be modified for coatings and films with various uses. Soy-protein coatings can prevent the loss of moisture and oxygen, which could be useful in maintaining the original flavor of foods.

*Food and Feed Processing Research, New Orleans, LA*  
*Frederick F. Shih, (504) 286-4354*

**An ornamental plant makes rubber** by using one of the same cell proteins as commercial rubber trees grown overseas. This discovery—the first of its kind in unrelated, rubber-producing plant species—moves ARS scientists closer to genetically engineering a domestic source of high-quality natural rubber. Currently, all natural rubber is imported—about a million tons a year valued at \$1 billion. Researchers found that a rubber protein in a common houseplant known as *Ficus elastica* is similar to one in latex of the *Hevea brasiliensis* tree, the world's primary source of natural rubber. Because this was the only rubber protein in common in these unrelated species, the researchers think the protein is essential in making rubber. They are now working to isolate other proteins key to rubber-making—and their responsible genes—in *H. Brasiliensis*. Then they can transfer the genes to domestic plants such as goldenrod. This fast-growing weed already makes a natural rubber, but the quality is low.



**A reinforced vinyl hammock** hanging about 30 inches above a truck bed reduced by two-thirds damage to the first six to eight inches of mechanically harvested carrots dumped into the truck in tests. The hammock, developed by ARS scientists, is attached to the sides of a high-lift or semi-truck trailer by tarp straps to break the fall of harvested produce. Dumping crops five to eight feet into an empty high-lift or trailer during harvest can damage them, especially the first six to eight inches of the crop hitting the bare steel bottom of the trailer. Researchers have worked with a Florida company to design a commercial version of the hammock, and say it could be available to vegetable growers within the next one or two years.

*Fruit and Vegetable Harvesting Research,*  
*East Lansing, MI*  
*Dale Marshall, (517) 353-5201*

**A potato's trip through harvesting and handling equipment** can leave it so bruised that it can't be stored for long and still be made into the light-colored chips consumers prefer. In recent studies, researchers tumbled an electronically equipped fake spud with real potatoes in a rubber-lined modified clothes dryer to simulate handling. The battery-powered artificial potato, developed by ARS and Michigan State University scientists, contains devices that detect and measure impact on potatoes along with computer circuitry to record the data. The researchers found that as potatoes are harvested and processed, it's not unusual for them to be hit with a force 30 times as strong as gravity. The study was designed to help assess bruising that occurs during harvesting, handling, sorting and shipping of potatoes.

*Potato Handling, Storage and Processing Research,*  
*East Grand Forks, MN*  
*Paul H. Orr, (218) 773-2473*

**Russet Burbank potatoes are less vulnerable** to skinning damage by harvesting equipment than most smoother skinned varieties. That finding emerged from skin shear tests conducted by ARS scientists concerned about susceptibility of potatoes to skinning abrasions during harvest and subsequent microbial infections. Using a University of Idaho testing device, the researchers also found the bud end of all varieties of potato tubers is most prone to skinning until the potatoes' skins are fully mature. Full maturity usually does not occur until after the potatoes are harvested and stored. ARS and Idaho researchers hope to find genetic crosses to produce hardy potato skins and pinpoint the best time to harvest with the least damage.

*Potato Handling, Storage and Processing Research,*  
*East Grand Forks, MN*  
*Edward C. Lulai, (218) 773-2473*

**Sticky clumps of spaghetti** may become a thing of the past, thanks to a test developed by ARS and North Dakota State University scientists to routinely monitor product quality. When spaghetti is sticky, chances are it was made from starch-damaged semolina—coarsely ground durum flour. Adapting a commercially available testing instrument, the scientists can predict stickiness in spaghetti made from different wheat varieties by checking for higher-than-normal amylose and sugars in semolina, cooked or uncooked spaghetti or cooking water. Their studies showed spaghetti is likely to have too much starch damage if the wheat was sprouted, the semolina was too finely ground or the spaghetti was overcooked. Researchers also found that mixing a type of fat called monoglyceride into spaghetti during processing decreased stickiness if the spaghetti was quickly dried at 148 degrees F.

*Cereal Crops Research, Fargo, ND*  
*Linda A. Grant, (701) 237-7060*

**Shampoo may one day get its foaming power** from the protein of the jojoba plant, rather than the animal proteins now frequently used as foaming agents. ARS scientists have developed a method to extract the protein from the seed of jojoba, an oilseed crop grown mainly in California and Arizona. Oil from the seed is currently used in a number of personal care products, and may also have potential industrial applications. The remaining portion of the seed is usually discarded. The protein discovery came out of continuing ARS research on uses for jojoba. Shampoo production in the United States in 1991 had a retail value of more than \$1.97 billion. (PATENT APPLICATION 07/919/341)

*New Crops Research, Peoria, IL*  
*Thomas P. Abbott, (309) 685-4011*

**Southwestern farmers could strike oil** by planting lesquerella, a native desert plant, a few years from now. That's because ARS scientists have nearly doubled the plant's yield of industrially valuable, oil-rich seed to more than 1,800 pounds per acre. The oil can be used in resins, waxes, nylons, plastics, high-performance lubricants, corrosion inhibitors and coatings, as well as cosmetics such as lipstick and hand soap. The seed's meal makes a high-protein supplement for livestock. Researchers started breeding work in 1985 with wild lesquerella plants that yielded less than 1,000 pounds of seed per acre. With additional breeding progress, lesquerella could become a new commercial crop as early as 1997. Farmers can use conventional equipment to plant and harvest it, and the seed can be processed by machinery already used with other oilseed crops. The research continues as a cooperative effort involving two private companies, Agrigenetics/Lubrizol and International Flora Technologies.

*U.S. Water Conservation Laboratory, Phoenix, AZ*  
*Anson E. Thompson, (602) 379-4356*



High-tech ceramic filters can help recycle the salty water (brine) used to chill processed meats after they've left the smokehouse. The salt lowers the water's freezing temperature, so meat packers can keep brine flowing even at 19 degrees F. Currently, to make the brine safe to use more than once, processors add chlorine to kill any bacteria. But preliminary results of ARS experiments show pumping brine through the ceramic filters traps the bacteria. The research, conducted in an ARS lab in California and a meat packing plant in Pennsylvania, might pave the way for federal approval of ceramic microfilters for this purpose. By increasing the number of times brine can be reused, filtration would reduce the amount packers send to wastewater treatment plants. Brine is unwelcome there: The salt harms helpful bacteria used for water clean-up.

*Food Safety Research, Albany, CA*  
Marcus R. Hart, (510) 559-6084

A technique called **supercritical fluid extraction (SFE)** can get unwanted gum out of crude soybean oil without creating waste by-products. ARS scientists adapted the environmentally friendly technique to improve soybean oil processing and cut costs. In SFE, gases such as carbon dioxide are heated and pressurized to act like liquids. Usually, chemicals, bleaching clay and water are needed in large amounts to remove gum from soybean oil. But SFE eliminates three steps typically performed in oil refining. The process could save the oil refining industry approximately 13,700 pounds of chemicals and 7,200 pounds of bleaching clay per day, as well as 45 gallons of water per minute. In tests, quality of oil processed under supercritical fluid extraction was equal to oil processed by conventional degumming methods.

*National Center for Agricultural Utilization Research, Peoria, IL*

Gary R. List/Jerry W. King, (309) 685-4011

Just a few lesser grain borer beetles releasing their natural chemical attractants in a bin of wheat may be enough to lure sufficient numbers of their brothers to seriously damage the wheat. Lesser grain borers are one of the most devastating pests in terms of damage to stored wheat, and can pose a problem in other stored grains as well. In tests, ARS researchers found that lesser grain borer adults were more attracted to wheat already infested with the borers than to clean wheat. Researchers will use the information about infestation patterns to help develop strategies for managing insect invasions in stored grain.

*Biological Research, Manhattan, KS*  
Alan K. Dowdy, (913) 776-2719

## Soil, Water and Air

Two fields on a north Mississippi farm have become five-acre laboratories for studying how growing soybeans with and without tillage affects water quality. Conservation tillage—including no-till—controls soil erosion but is suspected of harming water quality, mainly because it can require using more chemicals in the first few years, particularly herbicides, to kill weeds that would normally be plowed under the soil. Also, no-till's generally higher water infiltration rate allows more water and possibly more farm chemicals to leach below the plant root zone. Since 1990, scientists have measured the herbicide levels in surface runoff and shallow groundwater (up to five feet) several times during the growing season on the Nelson farm—one week, one month and three months after herbicides were applied. Over the three months, herbicide levels in surface runoff from both fields decreased rapidly to almost undetectable levels. Total herbicide losses in runoff from both fields were similar, but no-till allowed more herbicide to move deeper in the soil. For example, within four to five days after application (first rainfall), concentrations of all herbicides in shallow ground water beneath the no-till field were as high as 250 parts per billion (ppb) at the five-foot depth, whereas these concentrations under tilled fields were less than 10 ppb, regardless of depth. Only pre-emergence herbicides were detected in the runoff and shallow ground water. While about 100 times less sediment was lost under no-till, the practice has a greater potential for allowing some herbicides to move to deeper into groundwater. So far, the data do not indicate any overall water quality problems occurring when soybeans are grown no-till. However, this and other tillage practices must be studied for several more years before results are conclusive. Also planned are deeper groundwater sampling, measuring shallow groundwater movement and comprehensive soil sampling.

*National Sedimentation Laboratory, Oxford, MS*  
Sammie Smith, Jr., (601) 232-2936

A five-year study of a North Carolina watershed is helping farmers improve water quality by better managing fertilizer applications. In 1990, scientists began studying the 5,050-acre Herrings Marsh Run watershed in Duplin County, NC, as one of eight original demonstration projects funded under USDA's Presidential Water Quality Initiative. Herrings Marsh Run—typical of an eastern coastal plain watershed—has predominantly sandy soils and intensive agricultural practices, including 2,700 acres of cropland, 1,750 acres of woodlands, and 525 acres of farmsteads, poultry and swine facilities. To measure water quality, researchers installed 48 groundwater monitoring wells on 11 farms, and set up four stream monitoring stations. Preliminary results show that most of the stream and groundwater quality is acceptable, but that in some areas agriculture has



had a negative impact on water quality. The biggest problem: excessive nitrogen, either from commercial fertilizers or waste from poultry and swine facilities. USDA's Extension Service and Soil Conservation Service are working with farmers in the watershed to reduce unnecessary fertilizer and to improve water quality.

*Soil and Water Conservation Research, Florence, SC*  
*Patrick G. Hunt/Kenneth C. Stone, (803) 669-5203*

**Erosion-conscious irrigators should look before they leap into LEPA**—"low energy precision application." LEPA equipment, a relatively new commercial development in irrigation technology, often reduces irrigation water use and saves energy. But in ARS tests on sloping fields in Colorado, up to half the water ran off when applied by center pivot sprinklers with LEPA modifications. ARS researchers say this shows that farmers should carefully consider topography, soil type and other factors before converting to LEPA. Conventional center pivot irrigation systems use high pressure to spray water up and over crops. Converting to LEPA, say the researchers, is like taking a sprinkler nozzle off a garden hose and directing the water flow onto the soil. If LEPA equipment is used on steep slopes and heavy soils, water application rates could exceed the soil's ability to drink up the water before it runs away. Scientists measured 50 percent runoff on slopes of eight percent and about 30 percent runoff on three percent slopes. Luckily, farmers can use tillage practices, such as in-furrow soil dams (or micro-basins), to reduce this erosion potential. Much of the 12 million acres irrigated with center pivots in the United States is on slopes steeper than three percent and susceptible to erosion.

*Water Management Research, Ft. Collins, CO*  
*Gerald W. Buchleiter, (303) 491-8213*

## Scientific Information Systems

**Two new computer programs give farmers a better picture of how tillage practices affect crop residue.** Higher crop residue levels protect against soil erosion and add enriching organic matter to the soil. Residue Manager, based on field research in Iowa, helps farmers choose a tillage system that is best for the corn or soybean crop, as well as for the environment. It factors in residue type, summer stress, winter weather (which affects residue decomposition), moisture during tillage, the number and types of tillage operations and the desired residue amount. The program's final step shows the amount of residue left after planting the next crop. It graphically shows changes in residue depending on starting level, tillage type and residue decomposition. RESMAN—the Residue Management Decision Support Program—works in the same way for a larger geographic area. It analyzes data on 21 crops and considers winter loss of residue and more tillage practices. USDA's Soil Conservation Service and the

Equipment Manufacturers Institute used data that underlie these programs as one source for their calculations on the effects of tillage tools on residues. More than 15,000 copies of RESMAN and 50 copies of Residue Manager have been requested from the ARS scientists who developed them.

*National Soil Tilth Laboratory, Ames, IA*  
*Tom Colvin, (515) 294-5724*

*National Soil Erosion Research Lab, West Lafayette, IN*  
*Diane Stott, (317) 494-6657*

## Biological Control

**Simple tests used in human medicine have been adapted to reveal whether predatory insects have been dining on sweetpotato whiteflies.** Whiteflies resistant to insecticides have destroyed more than \$200 million in crops the past two years. ARS scientists have developed highly sensitive immunoassays similar to tests for screening urine for drug residues and pregnancy testing at home. Scientists can analyze the stomach contents of predatory insects to see if they have devoured whiteflies—or another insect. The immunoassays can tell if a predator's stomach holds partly digested whitefly adults or eggs. Scientists will use the results to identify which predators show the most potential for controlling the pest during each stage of its life cycle.

*Western Cotton Research Laboratory, Phoenix, AZ*  
*James R. Hagler, (602) 670-6709*

**A hormone that sterilizes female mosquitoes and other blood-sucking insects in laboratory studies offers a possible new way of controlling the pests outdoors.** A synthetic chemical mimic of the oostatic hormone, injected into female mosquitoes, prevented up to 98 percent of their eggs from forming. The hormone can also be fed to mosquitoes to interrupt egg development. It is only present during certain times in the insect's life cycle. If the hormone is put into the mosquito at the wrong time, it blocks the production of enzymes that female mosquitoes need to develop their eggs. The same reaction happens in biting midges, flies and fleas. The discovery of the hormone opens the way to inserting the hormone-producing gene in a mosquito parasite called a spiroplasma, which could then be sprayed or applied in some other way on mosquitoes in the field. It's part of an ongoing effort to find new ways to control harmful insects without using agrichemicals.

*Medical and Veterinary Entomology Research*  
*Laboratory, Gainesville, FL*  
*David A. Carlson, (904) 374-5929*

**A fungus native to Eastern Europe is a prime candidate as a biological control of leafy spurge weeds that infest Western states.** But the fungus has been difficult to study because it's hard to duplicate environmental conditions in a laboratory. Now ARS scientists have duplicated the



optimum native outdoor climate—including temperature, moisture and light—for germinating the fungus, *Uromyces scutellatus*, in the laboratory. Scientists also found that aromatic compounds produced by leafy spurge roots stimulate germination of the *U. scutellatus* teliospores—black spores which covered leafy spurge plants in Romania and were brought to an ARS quarantine lab for study. Since *U. scutellatus* is not native to the United States, it must be studied under quarantine. Leafy spurge plants infected by the fungus don't flower or produce seeds—effectively blocking reproduction, stunting growth and deforming the plant stems.

Foreign Disease/Weed Science Laboratory,  
Frederick, MD  
Rick Bennett, (703) 875-4105

A southeast Asian beetle that could devastate potato, tomato and other crops grown in South America and the United States has been discovered in Brazil by ARS scientists. Their discovery marks the first report of the Asian pest in a country of the Western hemisphere. Collected during an ARS expedition to Brazil in 1991, the beetle was identified a year later as *Epilachna vigintioctopunctata*. Produce shipped from Southeast Asia may have carried the beetle into Brazil. The spotted, yellowish-brown beetle infests crops in Southeast Asia that also are commonly grown in South America and the United States. Besides potatoes and tomatoes, these crops include alfalfa, beets, clover, cotton, eggplant, squash, and tobacco. In Southeast Asia and countries like Nepal, India, Pakistan, Australia and islands of the South Pacific, the beetles reduce crop yields by robbing plants of their energy-producing tissues. Because populations of the beetle in Brazil are small, scientists there can trace its movement and use bait traps or species of a predatory wasp to control it. USDA's Animal & Plant Health Inspection Service also has added the beetle to its quarantine list for potential pests of U.S. agriculture.

Insect Biocontrol Laboratory, Beltsville, MD  
Robert F.W. Schroder, (301) 504-5369

A wasp that cannot fly will attack only moths of the cotton bollworm and tobacco budworm. A natural mutation caused the wasp, *Microplitis croceipes*, to be flightless. This trait could keep the wasp and other natural enemies of crop pests in areas where they're placed. ARS researchers were the first scientists to discover the flightless trait and are studying the gene underlying its presence. The next step: isolate the gene and move it into other promising parasites of crop pests. Cotton bollworms (*Helicoverpa zea*) and tobacco budworms (*Heliothis virescens*) cause billions of dollars of damage to more than 100 crops. Developing new biocontrol techniques is important because these crop pests quickly develop resistance to chemicals used to control them.

Biological Control of Insects Research Laboratory,  
Columbia, MO  
William M. Steiner, (314) 875-5361

A phony sex bait foils the nighttime rendezvous of moths in mint fields. ARS scientists hope the tactic—which traps male mint root borers—will enable mint growers to know if and when to use insecticide against the troublesome pests. Their wormy offspring gnaw the underground stems of both peppermint and spearmint. Considered the worst pest of mint, borers have in rare instances wiped out entire fields. But female-hunting adult male moths can be lured into sticky traps by a synthetic version of the female moth's sex attractant, or pheromone. ARS scientists discovered that the moths mate mainly between midnight and 1 a.m. Scientists removed the pheromone glands from more than 800 moths to identify their unique sex scent and then created a synthetic copy. A California biocontrol company, Trécé in Salinas, CA, now produces the fake pheromone traps. Oregon State University researchers are testing the traps on peppermint fields throughout Oregon's Willamette Valley, where most of the country's mint grows. (PATENT APPLICATION 07/826,750)

Fruit and Vegetable Insect Research, Yakima, WA  
Harry G. Davis/Leslie M. McDonough, (509) 575-5945

Mass producing parasitic flies whose offspring feed on corn earworm and fall armyworm pests is now possible. ARS scientists can rear the fly, *Archytas marmoratus*, by feeding it greater wax moth larvae. The potential of the fly—native to the southern United States and to Central and South America—has been limited because it could not be reared in large enough numbers to be economical or practical. An *A. marmoratus* female can lay up to 3,000 larvae-eating maggots in her 50- to 70-day life span. The minuscule maggots initially attach and burrow into corn earworm and fall armyworm larvae, and complete their development by consuming the earworm and armyworm pupae. Scientists are preparing a 1993 field test of the fly against the corn earworm at Tifton. Corn earworms infest corn throughout the United States, causing an estimated \$1.2 billion in damage each year—not only to corn, but to cotton, tomatoes and other crops.

Insect Biology/Management Systems Research,  
Tifton, GA  
Harry R. Gross Jr., (912) 387-2343

Corn earworm larvae can't develop normally when fed certain natural plant chemicals. One of these chemicals, precocene II, impairs a larva's ability to digest and assimilate nutrients. ARS scientists are studying plant compounds such as precocene II that might serve as models for manufacturing "natural" pesticides. One strategy may be to genetically engineer crop plants to produce biopesticides harmful to a marauding insect. The corn earworm is one of



the most destructive pests of several U.S. crops including corn, cotton and tomato.

*Corn Insects Research, Ames, IA*  
*Bradley F. Binder, (515) 294-6948*

**Separating crop-damaging red sunflower seed weevil** larvae from gray sunflower seed weevil larvae can be tough, since they're all creamy white. But solving the identity crisis is important because parasites that might attack and control one type may not attack the other. ARS scientists are using a process called gas-liquid chromatography to sort out the weevils on the basis of their palmitoleic acid content; the gray weevils have more. Once the weevils' identities have been established, it will be easier to pinpoint which parasites will attack which weevils. Currently, adult red weevils are more destructive to sunflower crops because they're more numerous in Northern growing areas. But gray weevils, which mature a few days earlier and grow bigger, are on the rise. In 1991, farmers in North Dakota sprayed more than one million acres to control both sunflower seed weevil species.

*Oilseeds Research, Fargo, ND*  
*Brady A. Vick/Laurence D. Charlet, (701) 239-1322*

## Crop Production and Protection

**Elm trees may make a comeback** from the devastation of Dutch elm disease with two new ARS hybrid elms, Frontier and Prospector. Several wholesale nurseries are propagating these hybrids for the retail market in 1994. In tests, the hybrids showed high resistance to the Dutch elm fungus, elm leaf beetles and elm yellows disease. They have survived Minnesota winters in cold-hardiness tests and also have been successfully grown in Illinois, Oklahoma, Tennessee, Virginia and California. The hybrids were developed in an effort to produce trees that resemble American elms, but have the insect and disease resistance of Asian and European varieties. Scientists applied conventional breeding techniques—cross pollination for Frontier and seedling selection for Prospector—to select the desired traits. The widespread adaptability of the trees and their 35- to 45-foot height may appeal to urban landscapers. During autumn, the pyramid-shaped crown of Frontier blushes are reddish-purple and Prospector's vase-shaped crown turns yellow.

*Ohio Research Site, Delaware, OH*  
*Laurence Schreiber, (614) 363-1129*  
*National Arboretum, Washington, DC*  
*Alden M. Townsend, (202) 475-4848*

**Farmers will reap larger harvests** if crop plants get new genes telling them when to shed leaves, flowers and fruit—or when to hold on to them. Soybean plants naturally shed, or abscise, 70 to 80 percent of their flowers in response to

drought and other stresses. While stress is often short-lived, lost flowers mean fewer soybeans. An enzyme called cellulase is known to help bring about abscission, but ARS researchers are pursuing strategies to make the enzyme serve growers' objectives. They recently discovered that when leaves are shed, cellulase dissolves the biochemical glue between a single layer of stem cells and cells of the departing leaf. Researchers also isolated a bean gene that orders cells to make cellulase. By giving modified versions of the gene to bean, tomato and other test plants, researchers aim to identify the piece of this gene that acts as its on-off switch. Growers of apples, snap beans, cotton, oranges, nuts, tomatoes and other crops could harvest them more efficiently if the fruit abscised all at once instead of over a long period.

*Plant Molecular Biology Laboratory, Beltsville, MD*  
*Mark Tucker, (301) 504-6091*

**A new source of resistance to aflatoxin** has been produced from an ear of corn picked from a south Georgia field in 1980. During more than 10 years of tests, corn grown from kernels from the original ear averaged 60 percent less aflatoxin than susceptible kernels. Aflatoxin, a potent carcinogen, is produced primarily by the fungus, *Aspergillus flavus*, on corn during drought conditions. Resistance to aflatoxin is important because federal rules specify that raw grains or finished products cannot be sold across state lines for human consumption or animal feed if they contain 20 parts per billion or more of aflatoxin. Scientists say the new germplasm—officially called GT-MAS:GK—will provide corn breeders with an excellent source of germplasm for breeding resistance to aflatoxin into future hybrids. Plants grown from the GT-MAS:GK germplasm mature in about 110 to 115 days. They are most suitable for planting in the warmer conditions of the southern states. Yield varies from good to moderate, because the germplasm wasn't bred for genetic uniformity—meaning size, height and other traits often vary from plant to plant. About 10 seed companies have already asked for samples of GT-MAS:GK since it was released last year.

*Plant Resistance/Germplasm Enhancement Research, Tifton, GA*  
*Neil W. Widstrom, (912) 387-2341*

**Corn that cuts fall armyworm leaf damage** by 25 percent has been released to breeders after more than a decade of research. ARS, University of Georgia and Mississippi State University scientists released the new corn germplasm, designated GT-FAWCC (C5). Scientists developed it by screening several thousand plants and consolidating more than 100 collections from Mexico, the Caribbean, and Brazil. Resistance traits of these plants were combined in the germplasm for breeding commercial hybrids that farmers can use to counteract damage by fall armyworm larvae. This pest causes an estimated \$25 to \$30 million in



damage each year in the Southeastern states. The germplasm has a wide range of genetic variability, giving breeders more flexibility in how they use it to improve commercial corn. GT-FAWCC (C5) matures in about 115 days, making it more suitable to the Southern states than to the colder Northern corn belt. It also has good grain quality and better-than-average yield in hybrid combination with other corn populations—about 60 to 100 bushels an acre, comparable to some commercial hybrids now grown in the South.

*Plant Resistance/Germplasm Enhancement Research,  
Tifton, GA  
Neil W. Widstrom, (912) 387-2341*

**Citrus bacterial canker can be detected quicker** with a new "dot blot" test being patented. This worldwide plant disease scars citrus and leaves the fruit unmarketable. Scientists identified the sequence of a DNA fragment found in strains of the most serious and widespread form of the pathogen that causes citrus bacterial canker disease, *Xanthomonas campestris* pv. *citri* (Xcc). This sequence is not found in other bacteria. With this information, they developed a DNA probe for use in a "dot blot" test that is faster, more sensitive, and more specific than previous methods of detecting Xcc, and does not require that the bacteria first be isolated and grown in culture. The test works with lesions on leaves from affected citrus trees. A major problem in identifying the pathogen has been the presence of closely related strains of the bacteria that cause citrus bacterial spot disease, a leaf spotting disease of citrus in Florida nurseries. The new test identifies only strains of the bacteria that cause canker, and works in less than one day. Although citrus bacterial canker is not now present in the United States, more than \$100 million was spent on ridding Florida of the disease between 1984 and 1988. All suspect trees and nursery stock were destroyed. (PATENT APPLICATION 07/855,804)

*Fruit Laboratory, Beltsville, MD  
John S. Hartung, (301) 504-6374*

**Peach trees with a cell-cultured pedigree** fought off bacterial spot disease in their first outdoor tests. Every peach variety in the Southeast is vulnerable to the disease, caused by *Xanthomonas campestris* pv. *pruni*. The resistant trees developed by an ARS researcher began as cell cultures from embryos of Redhaven and Sunhigh peaches. In test orchards in 1990 and 1991, bacterial spot damaged half the fruit on conventional Redhaven trees, but only 13 percent on trees derived from lab-selected cells of a Redhaven embryo. Standard Sunhigh peaches had 50 percent more disease damage than peaches grown on trees from a Sunhigh embryo. To develop the test trees, the ARS researcher used plant hormones and nutrients to produce cell cultures from peach embryos and trigger changes in the cells' genes. A few of these cells survived a laboratory

face-off with a bacterial toxin known to have a role in the development and spread of the disease. From those cells, she generated midget trees smaller than alfalfa sprouts and, eventually, about 150 normal-size trees for the field test. The trees were planted by cooperators at North Carolina State University in 1987.

*Plant Molecular Biology Laboratory, Beltsville, MD  
Freddie Hammerschlag, (301) 504-5286*

**Tomato seeds don't lose their disease resistant** qualities during long-term space flights. That's what ARS scientists concluded after raising seeds of Rutgers's California Supreme and Better Bush cultivars that were carried aboard the Long Duration Exposure Facility satellite that orbited Earth for more than five years. After the flight returned from orbit on January 11, 1990, the seeds were planted and compared with their earth-bound counterparts. The test was to determine if there were differences in the plants' ability to resist natural infection caused by the early blight pathogen. The result: The rigors of cold and weightlessness during space flight had no adverse impact on the seed. Therefore, seed should be able to be carried on space stations or long duration trips throughout and beyond the solar system and be used to provide fresh vegetables for future astronauts.

*Genetics and Production Research, Lane, OK  
Vincent M. Russo, (405) 889-7395*

**Luring Medflies into traps is easier** if the bait's acidity is reduced. When the pH of a commercial protein bait, NuLure, was increased from 7.5 to 8.8, almost twice as many female flies were attracted to traps used to monitor Mediterranean fruit fly outbreaks and to capture the insects. Scientists suspect that lowering the bait's acidity affects the mixture of chemicals that lure Medflies, but researchers are conducting further studies to confirm that preliminary finding. California, Florida and other citrus-producing areas have been forced to spend millions to eradicate the Medfly to maintain fruit quality and retain their foreign markets. California is now using lower-acid NuLure bait in its Medfly monitoring program.

*Chemistry Research, Gainesville, FL  
Robert Heath, (904) 374-5730*

**A new southern pea cultivar produces seeds** that retain their fresh-green color during harvesting and processing. Developed by ARS researchers, the cultivar, called Bettergreen, contains a gene that keeps the seeds green up to four weeks after maturity. By then, seeds of most cultivars of this type have faded to a cream color. Bettergreen is ideal for commercial processors who mechanically harvest peas and want them to be as green as possible, even after blanching and freezing. Most mechanical harvesting equipment used by today's processing industry requires that the crop be at the near-dry or dry stages of maturity.



Bettergreen seeds retain 100 percent of their green color up to 28 days after reaching dry-stage maturity. Researchers expect the cultivar to be used by breeders who want to incorporate its seed color trait into current cultivars.

*U.S. Vegetable Laboratory, Charleston, SC*  
*Richard L. Fery, (803) 556-0840*

**Four new rust-resistant pinto bean** germplasm lines have been released to commercial plant breeders to develop new varieties for the market. The lines are resistant to all 64 available races of the bean rust fungus, *Uromyces apendiculatus*. Severe occurrences of this rust can cost bean growers as much as \$250 million annually in crop losses. The lines, known as BelDakMi-Rust Resistant-1, -2, -3, and -4, were released by ARS and the Agricultural Experiment Stations of North Dakota and Michigan. The BelDakMi lines derive their resistance from two wild bean strains first introduced into the United States from Latin America in the 1940s. The Latin American beans were crossed with several standard pinto bean cultivars to develop breeding lines for high quality, large pinto seeds, high yield, early maturity and resistance to the bean rust. BelDakMi lines -1 and -4 are also resistant to some strains of the bean common mosaic virus.

*Microbiology and Plant Pathology Laboratory,*  
*Beltsville, MD*  
*J. Rennie Staveland, (301) 504-6600*

**Soybean growers may be able to slash herbicide rates** and still maintain weed control if they mix herbicide with paraffinic oil instead of water. Tests show that a single gallon per acre of a mixture of herbicide and paraffinic oil, which is similar to mineral oil, controls johnsongrass better than 20 gallons per acre of a herbicide-water mixture. At low and ultra-low volumes, the paraffinic oil also outperformed soybean oil, cottonseed oil, No. 2 diesel fuel, kerosene and jet A fuel when used as a wetting agent to cause herbicides to adhere to plants. A newly designed ULV spray system, developed by ARS, is now available for low-volume and ultra-low-volume herbicide applications. Using this apparatus, growers can effectively apply herbicide rates lower than those recommended on the product label.

*Application Technology Research, Stoneville, MS*  
*Chester G. McWhorter, (601) 686-5293*

**Semi-dwarf soybean yields** can hit 100 bushels per acre under high-production management if the beans are irrigated and treated to extra nitrogen. In field tests in South Queensland, Australia, ARS and Australian researchers planted irrigated beans early in seven-inch-row spacing to get the highest yields. By applying nitrogen fertilizer, the researchers were able to boost yields from 80 bushels to about 100 bushels per acre. Normal non-irrigated soybean yields are 40 to 50 bushels per acre in the United States and

30 to 40 bushels in Australia. The tests pointed out that soybean plants need additional nitrogen to achieve yields over 70 bushels per acre. The nitrogen can be provided either through fertilization or improved nitrogen fixation—transforming atmospheric nitrogen into a form the plant can use.

*Corn and Soybean Research, Wooster, OH*  
*Richard L. Cooper, (216) 263-3875*

**A new hard red spring wheat variety** produces stiffer stalks that won't bend and break as the grain-laden heads mature. Growers can expect it to be available from certified seed dealers for large-scale planting in 1994. Developed by ARS and University of Minnesota scientists, the new variety—named Norm—will allow Upper Midwest wheat farmers to eliminate the practice of using growth-regulating chemicals to keep plant stalks from growing so tall they break under the weight of the grain heads. Eliminating the use of these chemicals will save both dollars and the environment. In field tests, Norm yielded 12 percent more grain than the popular wheat variety Marshall and seven percent more than the Vance variety. Norm also has good disease resistance, and is above average in bread-making qualities that the food industry and consumers prefer.

*Plant Science Research, St. Paul, MN*  
*Robert H. Busch, (612) 625-1975*

**Russian wheat aphids fare poorly** on a hard white spring wheat from Iran that may become a premier parent line for aphid-resistant bread wheats in the United States. Scientists found the Iranian wheat in evaluating approximately 9,000 bread wheat lines from the USDA-ARS National Small Grains Collection in Aberdeen, Idaho. They rated the Iranian line, PI 140207, tops in overall agronomic qualities from among 400 lines that are resistant to Russian wheat aphids. In greenhouse tests, offspring of aphids reared on the Iranian wheat line matured slowly and weighed only one-third as much as offspring of aphids reared on Pavon, a wheat susceptible to Russian wheat aphids. When researchers put healthy aphids on the resistant and susceptible wheats, PI 140207 suffered less damage. PI 140207 has been in the small grains collection since 1941—about 45 years before Russian wheat aphids first appeared in the United States.

*Wheat and Other Cereal Crops Research, Stillwater, OK*  
*Cheryl A. Baker, (405) 624-4212*

**Corn hybrids that are a cross** between Argentinean and U.S. lines will produce harder kernels for livestock feed and other uses, and are less likely to break before reaching export markets. Up to 640,000 metric tons of broken kernels and foreign matter—worth only about half as much as whole kernels—were removed from corn going from the United States to foreign markets last year. Until now,



crosses between Argentina's Cateto flint and U.S. dent corn produced harder kernels but lower yields than Corn Belt hybrids. Now ARS and Iowa State University geneticists have crossed select Cateto lines and the dent lines, Mo17 or B73, and found that adding a greater proportion of Corn Belt germplasm to the pedigree improved yield without sacrificing quality. Also, the researchers found the hybrids at harvest contain less moisture, reducing the need for artificial drying that sometimes increases breakage.

*Field Crops Research, Ames, IA*  
Linda M. Pollak, (515) 294-7831

It was a rice farmer's worst nightmare come true: Barnyardgrass, considered the world's worst weed in rice, refused to knuckle under to the herbicide propanil, the longtime remedy. Reports had surfaced about the weed's supposed resistance to propanil. But the precise timing required for successful herbicide use stirred doubts that the weed really was resistant. Then, in a major rice-producing county in Arkansas, a barnyardgrass population emerged that appeared to leave no doubts. Greenhouse tests soon showed the weed survived up to 10 pounds of propanil per acre. "Normal" barnyardgrass succumbed at doses of three pounds per acre. To knock out the weed, researchers found other chemicals that would do the trick each in tandem with propanil. None of the herbicides alone could provide control, but all are registered for use on rice and approved for tank-mixing.

*Rice Production and Weed Control Research,  
Stuttgart, AR*  
Roy J. Smith Jr., (501) 673-2661

Cotton's response to possible global warming may be a mixed bag of higher yields and greater vulnerability due to higher temperatures. USDA and Mississippi State University scientists grew two cultivars, Pima S6 and DES 119, in specially-designed growth chambers for 93 days. Plants exposed to high concentrations of carbon dioxide at an average daytime temperature of 79 degrees F produced more vegetative growth and more fiber. But when plants' internal temperatures climbed to 98 degrees or higher, flower buds stopped growing or fell from branches. Under typical circumstances, a plant's internal temperature may be as much as five degrees lower than the air temperature if the plant has adequate water. Cotton-growing regions such as west Texas or New Mexico frequently experience high temperatures, and such regions could be particularly hard-hit in the event of global warming.

*Crop Simulation Research Laboratory,  
Mississippi State, MS*  
James M. McKinion, (601) 324-4376

**Black plastic mulch produced 20 percent more irrigated summer squash planted in raised ridges of soil. Last summer's ARS field tests with the mulch, a commercially**

available black plastic film, were the first conducted on high-value vegetable crops in Colorado's irrigated high plains. The mulch also reduced weeds and risk of frost damage and led to faster growth. Most research on plastic mulches has been done in northeastern Europe and the eastern and western United States, where the practice is becoming more popular.

*Water Management Research, Fort Collins, CO*  
Gordon Kruse, (303) 491-8262

**Spraying gibberellic acid**, a natural plant growth regulator, on Stayman apples keeps them from cracking before harvest. Cracking in the skin and flesh of the apple can wipe out up to 80 percent of a Stayman crop. Disease-causing organisms invade the cracks and cause fruit to rot and fall from trees. Starting in early June, ARS scientists sprayed 50 to 100 gallons per acre using 20 to 50 parts per million of gibberellic acid at two-week intervals for two months. Four sprayings reduced cracking incidences to between five and 20 percent. EPA has approved gibberellic acid for use in apple orchards to reduce cracking. The disorder has been associated with moisture, but details have not been confirmed. Further research to study the cause of the disorder is planned with Virginia Polytechnic Institute scientists.

*Appalachian Fruit Research Station, Kearneysville, WV*  
Stephen S. Miller, (304) 725-3451

**Spraying citrus trees with abscisic acid** (a commonly used growth regulator) and other compounds will help protect Florida's citrus crop from freeze damage. These compounds allow young, immature citrus trees to supercool more deeply and survive at temperatures around 22 degrees F. Supercooling is the way plants protect themselves from freeze damage by keeping the temperature of internal cellular water below freezing. Young trees treated with the compounds have survived what normally would be a lethal freeze for up to two hours. The trees showed no injury and there was no evidence of ice forming in plant tissues.

*U.S. Horticultural Research Laboratory, Orlando, FL*  
George Yelenosky, (407) 897-7300

**A virus that's ravaging European orchards** could meet its match in a gene being tested in 36 U.S. plum trees. Plum pox virus is not present in this country but is one of the most serious diseases of plums and apricots in Europe. A coat protein surrounds a virus. Researchers have inserted into the experimental plum trees the coat protein gene of a papaya ringspot virus. They hope to see the protein produced in the plum trees. Viral coat protein genes have been used in other crops to protect them against other viruses. The protein expressed by the gene interfered with virus multiplication in plants. The experimental trees were planted at Kearneysville, WV, in November 1992. The potential increase of travel and exchange of goods between



the United States and Eastern Europe and the former Soviet Union heightens the risk of plum pox virus striking U.S. orchards. This disease is a potential threat to stone fruit production and a major concern of plant quarantine agencies in the United States.

*Appalachian Fruit Research Station, Kearneysville, WV*  
*Ralph Scorza, (304) 725-3451*

**Leaf quality could be improved** and fruits could be made sweeter naturally by changing the rate at which sucrose is produced by the plant. ARS researchers have isolated the gene for an enzyme known as sucrose phosphate synthase (SPS) from spinach. SPS is a key enzyme in sucrose production, but it's been difficult to study because very little is found in plants. Now researchers have incorporated the SPS gene into *Escherichia coli* bacteria to produce large amounts of the enzyme for further study. With bacterial-produced SPS, they've identified an important region of the enzyme that gives clues as to how SPS can be made to work more efficiently. The next step is to make changes that improve the enzyme and put it back into tobacco plants to determine how sucrose metabolism and photosynthesis are altered.

*Tobacco and Forage Research, Lexington, KY*  
*Michael Salvucci/Robert R. Klein, (606) 257-2683*

**Mutant tomato plants are helping scientists** learn how to alter plants to adapt to their environment. Four major classes of roots on the tomato plants have been recognized: tap roots, the first to appear in germination; basal or seminal roots, the first large roots to appear; lateral roots that explore the soil; and adventitious roots that emerge from the plant's stem and help the plant stand. The scientists have succeeded in genetically manipulating the tomato plants' combination of roots. Now they're probing whether the various root types have different functions, from taking up water to absorbing nutrients. One early discovery: When plants are stressed, they can sprout tiny hairlike roots, sometimes in a matter of hours, to search every nook and cranny for water or nutrients.

*U.S. Plant, Soil and Nutrition Research, Ithaca, NY*  
*Richard W. Zobel, (607) 255-4573*

**A new cayenne pepper has been released** that's ideal for home gardeners who want a compact, high-yielding variety for their chili and other spicy foods. Called Charleston Hot, the two-inch-long pepper is resistant to all four known races of the southern root knot nematode, a serious pest that can damage plant roots and cut pepper yields by up to 50 percent. Charleston Hot is ideal for home gardening because the plant only grows about 18 inches high and takes up little space. It also has an unusual trait for a cayenne pepper—as it ripens, it changes from yellow-green to golden yellow, bright orange and finally to deep red at

maturity. Charleston Hot can be grown in most areas of the United States. Seeds are available to breeders and gardeners by writing to the U.S. Vegetable Laboratory, 2875 Savannah Highway, Charleston, SC 29414-5334.

*U.S. Vegetable Laboratory, Charleston, SC*  
*Philip D. Dukes/Richard L. Fery, (803) 556-0840*

**A search for natural weapons** against a pest plant has helped fill some gaps in scientific knowledge about the *Hispinae* subfamily of chrysomelid beetles. Researchers were seeking natural enemies of *Baccharis salicifolia*, also known as seepwillow, a woody shrub that saps precious water and clogs streams in western Texas, New Mexico and Arizona. Instead, on the less significant *Baccharis bigelovii* in Arizona, they found large numbers of a *Hispinae* beetle called *Pentispa suturalis*. Little was known about the biology of *Hispinae* beetles. But repeated visits to the area revealed many new details, such as the fact that adults overwinter in leaf debris, emerge in April and May and feed by removing strips of leaf tissue from between the veins. The female beetles lay their eggs primarily on the underside of the plant's leaves. They chew a hole in the leaf, insert an egg and cover the hole with digested material. The emerging larvae live in blotch-type mines and severely damage the plant as they feed. While *P. suturalis* beetles do not eat seepwillow, information about how they attack *B. bigelovii* could help scientists in their search for predators of seepwillow by providing clues to insect hiding places and characteristic signs of attack. Controlling seepwillow with a natural enemy would mean less water wasted by the weed—and more water available for consumers and agriculture in the arid Western states.

*Grassland Protection Research, Temple, TX*  
*Paul E. Boldt, (817) 770-6530*

**Plants appear to have a "sensitive spot"** at the tips of their roots when it comes to exposure to aluminum. Aluminum toxicity is the primary problem limiting agricultural production on acid soils—the type of soil seen in approximately half of the world, including the northeastern and southeastern United States, South America and Africa. In laboratory tests, when aluminum was applied to other parts of the roots, the plants were able to continue functioning normally. But when aluminum was applied to plant root tips, root growth was inhibited within a matter of hours. Excessive aluminum also interferes with the plant's ability to take up calcium from the soil. Calcium is essential for plant cell function, and the cellular calcium levels also serve as a biological "switch" which regulates other processes in the plant.

*Plant Protection Research, Ithaca, NY*  
*Leon V. Kochian, (607) 255-2454*

**Planting pine trees into clover** can give the young trees extra growing power, but results are best when the clover gets some human help against competing vegetation. The clover transforms nitrogen from the air into a form usable to the trees as fertilizer—a process called “fixing” nitrogen. In tests, researchers planted loblolly or slash pines in subterranean clover pasture. In some sites, warm-season vegetation that might compete with the clover was held at bay by applying herbicides or disking the soil. Trunk diameters measured 4.76 inches in seven year-old pines where the clover had no competition, compared with 4.37 inches for trees planted in clover left to fend for itself among the vegetation—an increase of about nine percent. Clover yields equalled 3,371 pounds per acre where herbicides or disking were used, compared with 571 pounds where the clover was unassisted. Pine trees are planted in Southern states for lumber, and also may be grown as windbreaks or alternative crops.

*South Central Family Farms Research Center,  
Booneville, AR  
Henry A. Pearson, (501) 675-3834*

**Pecan weevils can be fooled** into a deadly trap with a few dollars worth of whitewash, a little paint and some masonite panels. The masonite traps are shaped like a pyramid, about 21 inches wide and 48 inches tall, and are painted brown to resemble a tree trunk. When adult weevils emerge from the soil during August and September, they usually crawl or fly to the dark trunk of a pecan tree. By whitewashing tree trunks, however, scientists diverted this costly pest to the brown-painted trap from which they cannot escape. Ten to 15 traps per 100 acres should be used initially. Each trap should be placed eight to 10 feet from the tree trunk by mid-July and inspected every two or three days. Chemical control of the weevil is available, but spraying also kills most of the beneficial insects. Growers may use this method to monitor the weevil to more accurately pinpoint peak outbreaks.

*Southeastern Fruit and Tree Nut Research Laboratory,  
Byron, GA  
W. Louis Tedders, (912) 956-5656*



# Quarterly Report

## of Selected Research Projects

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Service



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### Into the Marketplace

#### Cooperative Research and Development Agreements

...With Organic Plus, Inc. of Albuquerque, NM, to develop new, non-chemical methods to more effectively control fire ants, a human and agricultural pest in southern states and Puerto Rico. Scientists will work to improve a natural control called diatomaceous earth (DE), the skeletal remains of tiny organisms called diatoms. DE kills fire ants by damaging their protective skins. ARS scientists will conduct tests on attractants to add to the DE mixture to lure fire ants to a bait. And they'll use DE as a carrier of fire ant repellents that can be used to keep the pests out of parks, picnic areas and other areas where people come into contact with them.

*ARS Contact: Robert K. Vander Meer, Medical and Veterinary Entomology Research Lab, Gainesville, FL, (904) 374-5918*

...With Embrex Inc. of Research Triangle Park, NC, to determine if broiler chickens will be leaner if the develop-

ing eggs are injected with insulin-like compounds. Each year the broiler industry loses \$500 million in chicken feed that birds use only to make a triangular mass of abdominal fat that is discarded. Researchers will also see if treating eggs with hormones will lead to improved feed efficiency, less time to market weight and stronger resistance to disease. Such improvements could reduce poultry producers' costs while providing consumers with a more desirable product. Genetically engineered insulin-like compounds are being supplied to ARS scientists and Embrex by Gropep Inc., Adelaide, Australia. In preliminary tests, eggs in various stages of development are being injected with a peptide hormone growth factor. Any hormone for use in chicken eggs would have to be approved by the Food and Drug Administration before it can be sold to consumers.

*ARS Contact: John P. McMurtry, Non-Ruminant Animal Nutrition Laboratory, Beltsville, MD, (301) 504-8803*

...With Continental Colloids, Inc. of West Chicago, IL, to explore commercial development of food additives made from cornstarch and naturally-occurring gums, such as guar, which is isolated from the guar plant. In studies on new uses for farm crops, ARS researchers found that the starch-gum mixtures have many of the properties required for food thickeners and fat substitutes. A mixture of about 95 percent cornstarch and gum will be tried as a thickener in dairy products. Natural gums, such as xanthin and guar gums, already are being used as thickeners in food products such as puddings, pie fillings, and salad dressings. (PAT-ENT NO. 07/991,811)

*ARS Contact: George F. Fanta, Plant Polymer Research, Peoria, IL, (309) 685-4011*

#### Patent Licenses

...To Agdia, Inc. of Mishawaka, IN, to produce and market two diagnostic kits that detect plant-damaging organisms. ARS scientists developed the kits. One detects at least 55 plant-damaging viruses that can lower the market value of vegetables and ornamentals by 75 percent. A patented monoclonal antibody probe identifies the plant-threatening potyviruses. Potyvirus-affected plants include beans, lettuce, potatoes, wheat and many other crops as well as lilies, irises and tulips. A second kit detects the potato spindle tuber viroid, using a radioactive DNA clone of the viroid. Nearly all potato breeder and seed certification programs in the world are using the technique to screen for the viroid—a devastating disease of potato breeding. The potyvirus kit is used by seed companies, plant breeders,

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.



private labs and food companies to assure that seeds and plants are disease-free. As ARS scientists continue their research on plant diseases, the number of potyviruses detectable by the kit—the first to detect such a broad spectrum of plant viruses—will expand.

*ARS Contacts: Ramon L. Jordan, Florist and Nursery Crops Laboratory, Beltsville, MD, (301) 504-5646  
Robert A. Owens, Microbiology and Plant Pathology Laboratory, Beltsville, MD, (301) 504-6209*

...To Griffin Corp. of Valdosta, GA, to further develop a new class of insecticides discovered by ARS scientists. The insecticides, called fluorosulfonates, control cockroaches, ants and other insect pests that live in colonies. The compounds don't kill worker insects right away. Before they die, they bring the insecticide-treated bait back to the nest, where other insects eat it and die. Griffin secured patents on the research in 1990 and 1993 on behalf of USDA, which issued an exclusive license to the company. Griffin since issued two sublicenses—one to S.C. Johnson, of Milwaukee, WI, which has already produced commercial products for controlling household ants and cockroaches. The other sublicense was issued to FMC, a leading chemical producer based in Chicago. FMC expects to produce and market the fluorosulfonates in several other products over the next two years. (PATENT 5,177,107)

*ARS Contact: Robert K. Vander Meer, Medical and Veterinary Entomology Research Lab, Gainesville, FL, (904) 374-5918*

## New and Improved Products

Identifying the best yeasts for baking, brewing and other food uses is easier with an improved test keyed to yeast's genetic makeup—or DNA. Developed by ARS scientists, the gene-based system could be ready for commercial use in five years. The system can pinpoint unwanted as well as helpful strains—crucial to foodmakers guarding against intruder yeasts in fermentation vats or mixing bowls. Unwanted yeasts, though not harmful, can change food flavor or texture or reduce yield in fermentation vats. The new system is the first to distinguish food yeasts by matching samples of DNA from entire chromosomes of yeast. That makes the technique more accurate than methods relying on DNA from bits and pieces of chromosomes. In addition, unlike some current yeast ID methods that require about 50 different tests, the new test, when ready, would be simpler to use. (PATENT APPLICATION 07/695,167)

*Process Biotechnology Research, Albany, CA*

*A. Douglas King, Jr./David R. Rockhold, (510) 559-5851*

Cornstarch makes up 90 percent of new, biodegradable foam "peanuts" used inside packing and shipping boxes. ARS scientists hold a patent for the starch material. A

plastic polymer is chemically attached to form what's called a starch graft copolymer. This is similar to a nurseryman grafting a branch of one variety of apple tree onto another variety. ARS granted an exclusive license to the Agricultural Utilization Research Institute of Crookston, MN, to further develop this technology. Several other commercial products are expected to be introduced using starch graft copolymers.

*Plant Polymer Research, Peoria, IL  
William M. Doane, (309) 685-4011*

Itchy rashes and other allergic reactions to rubber products could be prevented by using allergen-free rubber from a desert shrub, guayule. Lab tests by ARS scientists revealed that guayule rubber—extracted from the plant's stems and bark—is free of allergy-causing proteins found in many of today's natural rubber products such as gloves and condoms. In contrast, proteins in latex from the world's primary source of natural rubber, the tropical *Hevea brasiliensis* rubber tree, can cause allergic reactions ranging from prickly rashes to, in rare cases, life-threatening shock. Following lab experiments, the ARS scientists collaborated with medical researchers who tested more than 60 volunteers allergic to *Hevea* latex. When they were given a standard allergy test using a tiny amount of guayule rubber, none had an allergic response. If further tests confirm the preliminary findings, guayule could attract new interest as a high-value, specialty crop for U.S. farmers in the southwest.

*Process Biotechnology Research, Albany, CA*

*Katrina Cornish/Deborah J. Siler/Ok-Koo K. Grosjean, (510) 559-5950*

Rescue personnel can be better prepared to help victims of Africanized honey bee attacks, thanks to ARS research. A bee researcher found that several fire-fighting chemicals normally carried on fire trucks, or even ordinary liquid dishwashing detergent, halt bee attacks immediately and kill bees in 60 seconds or less. The researcher has supplied the information, plus tips on how to avoid confrontations with the highly defensive bees, to journals and magazines for rescue personnel.

*Carl Hayden Bee Research Center, Tucson, AZ  
Eric Erickson, (602) 670-6380*

A machine called a gravity table may net higher prices for American soft white winter wheat exported to Pacific Rim countries. This could happen next year if a new ARS method passes further tests using the tables to separate the most valuable—low-protein—kernels. Millers and bakers in Japan and other Pacific Rim countries pay more for wheat with less than 10.5 percent protein, because the flour makes better steam bread, sponge cake and other foods. The gravity table's combination of a tilted, vibrating surface, and tiny jets of air emitted from holes in the surface, segregates the kernels as they move to the table's



edge. Heavier, lower-protein kernels drop into boxes at the upper portion of the edge. Standard tests with sorted kernel samples can be employed to determine the wheat's exact protein level. Gravity tables are used commercially to separate small or broken kernels from those suitable for planting as seed. The new method should especially help growers on non-irrigated farms in Oregon, Washington and Idaho where wheat protein content varies widely. In 1992, Pacific Rim countries bought half the region's billion-dollar, 200-million-bushel crop of soft white wheat.

*Columbia Plateau Conservation Research Center,  
Pendleton, OR*

*Dale E. Wilkins/Clyde L. Douglas, (503) 278-3292  
National Forage Seed and Cereal Research, Corvallis,  
OR*

*Donald B. Churchill, (503) 750-8744*

**Wild soybean relatives hold a key to giving people and livestock the benefit of soy protein without the need for an extra step to process the crop.** Commercial soybeans have compounds called trypsin inhibitors that must be removed or inactivated by heat, solvents or other means to protect the protein's nutrient value. But thanks to research at ARS and the University of Illinois, farmers 10 years from now may grow varieties that are free of the unwanted compounds. In 1991, ARS and University scientists offered plant breeders a commercial soybean variety that has only a trace of one type of trypsin inhibitor, known as Kunitz. ARS tests indicated that low-Kunitz soybeans require less processing to remove the remaining inhibitor compounds. In 1992, researchers took another step toward eliminating the inhibitors altogether. In an ARS soybean gene bank, they found several wild relatives of the plant that contain only a minuscule amount of second inhibitor type called Bowman-Birk. University scientists used an ARS-developed molecular probe to pinpoint these special plants among more than 13,000 samples. The next step: Scientists must breed the low-Bowman-Birk trait into low-Kunitz soybeans. That would yield an ultra-low-inhibitor soybean that commercial breeders could develop further for farmers.

*Plant Physiology and Genetics Research, Urbana, IL  
Charles Cremeens, (217) 333-1117*

*Food Safety Research, Albany, CA*

*Mendel Friedman/David Brandon/Anne Bates, (510)  
559-5642*

*University of Illinois, Urbana, IL*

*Theodore Hymowitz, (217) 333-9454*

**A single gene dubbed "EVG" appears to control dormancy in peach trees,** a discovery that could lead to breeding peach trees that are less vulnerable to early fall or late spring freezes. During dormancy, deciduous trees lose their leaves and stop growing, and their built-in genetic defense against cold weather damage goes into action. But if cold weather hits while these trees are not in dormancy,

damage can occur. Scientists found the dormancy-control gene in evergreen peach trees in Mexico and named it EVG. The mechanism by which plants become dormant and how dormancy relates to cold hardiness are not well understood. Discovery of this single dormancy-controlling gene will help address these fundamental issues and may lead to developing cold hardy trees. Scientists from an ARS lab in Byron, GA, the Colegio de post-Graduados in Chapingo, Mexico, and the University of Florida collaborated in the research.

*Appalachian Fruit Research Station, Kearneysville, WV  
Ralph Scorza, (304) 725-3451*

**A species of bacteria** discovered by ARS scientists may lead to the use of jojoba as a source of cattle feed. Jojoba is an oilseed crop grown in the southwestern United States and used in the cosmetic industry. Meal made from jojoba has potential as a cattle feed supplement, but the meal contains toxins that cause weight loss in cattle. In studies, *Lactobacillus arizonae* bacteria broke down these toxins, making the meal potentially safe for cattle consumption. *L. arizonae* has been deposited in the ARS Culture Collection at Peoria, IL, as NRRL B-14768 and is available to researchers.

*Microbial Properties Research, Peoria, IL  
James L. Swezey, (309) 685-4011*

**ARS and Food and Drug Administration scientists co-invented a pelletized moisture-absorbing processing aid** that reduces chemical analysis time for fat- and moisture-laden foods from five hours to 30 minutes. The material absorbs moisture and disperses the sample, permitting easier extraction of fatty foods such as hamburger. This eliminates the need to oven- or freeze-dry moist food samples, thus saving time for laboratories doing sample preparation. Several companies are interested in licensing the invention. (PATENT 5,151,188)

*Food Quality and Safety Research, Peoria, IL  
Jerry W. King, (309) 685-4011*

## **Animal Production and Protection**

**Two genes in sheep** have been linked to the fat content of lamb. This finding could help breeders select sheep most likely to yield lower-fat lamb chops, roasts and cutlets. ARS scientists analyzed genetic material from 18 lambs and took 10 fat-related measurements such as weight, bodywall thickness and kidney fat. In the fatter lambs a gene called adipocyte P2 was more active and one called lipoprotein lipase was less active. Once researchers determine which genes are the most accurate predictors for lean meat, a simple blood test taken at birth might be all it takes to identify the best animals to use for breeding.

*Sheep Production and Efficiency Research, Dubois, ID  
Gary D. Snowden, (208) 374-5306*



A simple blood test for calves may help beef producers put leaner meat on our tables. One way of obtaining lean-beef animals is to use bulls produced by crossing traditional breeds with so-called "double-muscled" breeds that have larger muscles and very little fat. But not all bull calves from these unions inherit traits for lean meat. To identify those that do, ARS researchers developed a blood test that measures levels of creatine, a protein produced by muscles. In all cases, calves that inherited the double-muscle, lean-meat traits had higher levels of creatine.

*Meat Science Research Lab, Beltsville, MD*  
Morse B. Solomon, (301) 504-8400

A special genetic "insulator" tested in mice could help scientists ensure that new genes inserted in farm animals turn on and off at the proper time. Currently, these new genes sometimes don't function when desired, and this is hampering efforts to genetically improve cattle, sheep and pigs for disease resistance, leaner meat and other traits. ARS molecular biologists showed that a newly inserted gene can benefit from a genetic insulator, known as a matrix attachment site. The insulators are points on a chromosome that serve as a boundary, separating an individual gene from its neighbors, so the gene is less likely to turn on—or off—just because its neighbors do. To test this approach, scientists inserted a milk protein gene along with its insulators into laboratory mice. With the insulator sites, the gene's behavior was almost identical to the naturally occurring gene. But without the insulators, the gene turned on and off erratically.

*Reproduction Laboratory, Beltsville, MD*  
Robert J. Wall, (301) 504-8362

**Supercharged white blood cells** (known as neutrophils) may soon be deployed to fight mastitis, a disease of cows' udders that costs U.S. dairy farmers \$2 billion annually for treatment and lost milk production. Neutrophils are part of a cow's first line of defense and fight infection by surrounding, engulfing and killing invaders with a burst of hydrogen peroxide. In laboratory tests, neutrophils treated with monoclonal antibodies produced 10 times as much hydrogen peroxide and became very active in finding and killing bacteria. The added boost is needed because some neutrophils are lazy and not very active, taking 24 to 48 hours to arrive in the udder—by this time an infection may have already taken hold. If the "souped-up" neutrophils are as aggressive in cows as they are in the test tube, the system may replace antibiotics as a treatment for mastitis.

*Milk Secretion and Mastitis Lab, Beltsville, MD*  
Max Paape, (301) 504-8302

A cold-water jacuzzi containing a touch of vinegar could clean up the chicken-borne *Salmonella* problem, tests show. ARS engineers injected pressurized air into the first cold water bath on the chicken processing line—where a lot of the *Salmonella* cross-contamination occurs. Air scrubbing

dramatically reduced the number of carcasses that came out of the bath with bacteria, but it made the birds' skin absorb more water than regulations allow. So the scientists added 0.6 percent acetic acid—which makes vinegar taste sour—to tighten the skin. In tests with chickens that had been artificially inoculated with *Salmonella*, the forced air water bath cut contaminated carcasses by 90 percent compared to the plain water bath currently used. And the small amount of acetic acid reduced water retention to acceptable levels. The treatment leaves a slight yellow tint on the birds. The technology is now ready for full-scale testing by the poultry industry.

*Poultry Processing and Meat Quality Research, Athens, GA*  
James A. Dickens, (706) 546-3205

**Scientists have unraveled the mystery of why parasites sometimes cause calves to end up as runts**—bringing researchers closer to solving the problem. Many immature calves infected with parasites, such as the protozoa *Sarcocystis*, never reach their full growth potential. During infection certain white blood cells secrete proteins called cytokines. One of these cytokines manipulates the hormones that regulate the animals' feed intake, their nutrient utilization and, ultimately, their growth. This cytokine is called "tumor necrosis factor" (TNF) because when first discovered it was shown to attack and kill certain types of tumors. Studies show that TNF circulating in the blood of the test calves caused a decrease in insulin-like growth factor 1, a hormone necessary for growth. At the same time, it caused an increase in the hormone somatostatin, which blocks growth. These alterations in the infected calves persisted even after the symptoms of infection were gone. This growth reduction may be a survival mechanism whereby the animal mobilizes its metabolism to fight off infection at the expense of increasing in size. Now the researchers want to find ways to reverse the effects TNF has on the growth of parasite-infected calves.

*Zoonotic Diseases Laboratory, Beltsville, Md*  
Ronald Fayer, (301) 504-8201

**A new experimental vaccine to protect livestock from foot-and-mouth disease** has been custom-built in the "shell" of another virus. In preliminary tests, it prevented infection of guinea pigs and pigs. The foot-and-mouth virus infects cattle, pigs, sheep and other cloven-hoofed animals, causing severe economic losses in foreign countries. ARS wants an improved vaccine that would cut both the risk and the cost of potential outbreaks in this country. Researchers began building the vaccine by cloning the pieces of the virus' outer shell. They also cloned the enzyme that assembles all the pieces to form a whole shell. Then they inserted the genetic code for these parts into an *E. coli* bacterium. The genetically altered bacterium produces a structure that resembles the foot-and-mouth virus but lacks the element



that enables it to infect animals and multiply to cause disease symptoms.

*Plum Island Animal Disease Center, Greenport, NY*  
*Marvin J. Grubman, (516) 323-2500*

**A compound similar to a natural product isolated from the fungus, *Aspergillus japonicus*, could protect U.S. cattle and swine from the virus that causes foot-and-mouth disease.** ARS researchers found that in lab tests the compound, E-64d, limited virus reproduction to less than 0.1 percent of normal rates in infected animal cells. Next, ARS scientists will test to see if the compound can protect susceptible animals from infections at a quarantine lab. Foot-and-mouth disease causes severe economic losses for foreign producers. The virus is not present in the United States, but anti-viral vaccines or drugs would cut the potential risk and cost of outbreaks here. E-64d works by inhibiting production of a viral protein that the virus needs to multiply. Medical researchers are studying E-64d, which was synthesized by Japanese researchers as a potential treatment for heart attack, muscular dystrophy and other muscle-related diseases.

*Plum Island Animal Disease Center, Greenport, NY*  
*Marvin J. Grubman, (516) 323-2500*  
*Biochemistry and Chemistry of Lipids Lab, Wyndmoor, PA*  
*Phillip E. Sonnet, (215) 233-6412*

**A parasite that causes a serious disease of chickens uses the birds' own T-lymphocytes, a type of white blood cell, to hide and be transported to the intestine where it develops.** Chicken coccidiosis disease costs U.S. chicken farmers \$450 million annually in medication and production loss. This discovery by ARS scientists marks the first time the cells that transport and protect parasites have been identified in this protozoan disease. Normally, two types of blood cells, lymphocytes and macrophages, are a chicken's major line of defense against infection. But the scientists found these cells carry the invasive, or sporozoite stage of the coccidial parasite into the deepest crevices of the intestinal wall. There, the sporozoites are shielded inside these blood cells, safe from other lymphocytes and macrophages that normally would destroy them. In other research, scientists found that previously infected chickens develop immune cells that secrete proteins called lymphokines that activate other lymphocytes and macrophages to destroy parasites. On the basis of these tests they hope to devise control strategies to protect chickens against coccidiosis. To track *Eimeria acervulina*, one of five protozoan species that cause coccidiosis, the scientists used custom-designed monoclonal antibodies and fluorescent dyes.

*Protozoan Diseases Lab, Beltsville, MD*  
*Hyun S. Lillehoj, (301) 504-8771*

**Genetic engineering has yielded promising results for development of experimental vaccines against chicken**

coccidiosis. The vaccines partially protected chickens from the disease in experimental trials, and the birds gained weight at the same rate as birds protected by drugs. Coccidiosis costs the broiler industry \$450 million annually in medications and lost meat production. An effective vaccine would allow producers to greatly reduce or eliminate use of preventative medications, to which the microscopic coccidia parasites eventually become resistant. Commercial vaccines based on this research may be available in five to 10 years. To develop the vaccines, ARS scientists copied certain genes from the parasite itself. These genes produce antigens—proteins from the parasite's surface—which the chicken's immune system "sees" and responds to by producing antibodies. The scientists produced quantities of the antigens by splicing copies of the genes into the harmless bacterium, *E. coli*, and growing it in lab cultures. (PATENT APPLICATION 07/308,219)

*Protozoan Diseases Laboratory, Beltsville, MD*  
*Harry D. Danforth, (301) 504-8427*

**Using quick and easy-to-use cotton swabs to obtain oral secretions, researchers detected highly pathogenic avian influenza virus in infected chickens in less than two days.** By contrast, the standard test for the virus requires harder-to-get blood samples and may take a week to complete. Now being refined for commercial use, the new test uses a technique called polymerase chain reaction (PCR) along with DNA sequence analysis which produces highly accurate results. Scientists make millions of copies of the viral genes in an oral swab from the birds. This gives them enough material to see if the virus is one of the two highly pathogenic types of avian influenza virus. Pathogenic avian influenza does not occur often in the United States, but when it does, whole flocks must be destroyed to prevent its spread. A 1983 outbreak in Pennsylvania and Virginia cost taxpayers \$63 million for indemnification.

*Southeast Poultry Research Lab, Athens, GA*  
*Michael L. Perdue, (706) 546-3435*

**Genetically engineering disease resistance into animals has taken one small step forward.** A mouse gene that produces an antibody against *Escherichia coli*, a common bacterium, was successfully inserted into mice, pigs and sheep. High levels of the antibody were detected in the serum of the mice and pigs, and the antibody was detected in one type of white blood cell in one of the sheep. Because this is only one of many antibodies to *E. coli*, it is not enough to provide immunity for the animal. But, it illustrates that immunity can be "programmed" into the genes of animals.

*Gene Mapping and Evaluation Lab, Beltsville, MD*  
*Vernon G. Pursel, (301) 504-8114*

**A new growth medium successfully supports animal embryos through a crucial stage of incubation in culture tubes.** Genes can be inserted into embryos, but the resulting



embryos must be capable of continued normal growth. ARS scientists developed a single growth medium—fluid with nutrients and salts—to replace four media currently used. The new medium supports the egg through a 24-hour maturation period, as well as through fertilization and the following 72 hours, when an embryo divides to form 32 to 64 cells. At that stage, scientists can transfer the embryo to an incubation system which will support continued development needed for the production of live offspring. With a single medium, there is less handling and, in turn, less chance of contamination and shock to eggs and embryos. Using one medium also makes work with large numbers of eggs and embryos simpler and more economical.

*Gene Evaluation and Mapping Laboratory, Beltsville, MD*

*Ross A. Waterman, (301) 504-8543*

**Crimson clover resistant to fusarium wilt** could soon be sprouting in pastures for the first time. That's because breeders can now cross new wilt-resistant lines developed by ARS with commercial strains to provide farmers with the first-ever wilt resistant varieties. The wilt-causing *Fusarium* fungus normally kills commercial varieties. Crimson clover is an annual forage plant, grown in the Pacific Coast states and from the Gulf of Mexico north to Maryland, southern Ohio and Illinois. Its ability to serve as a natural fertilizer also makes it a good "green manure" that improves fertility of land used later to grow crops like corn.

*Crop Science Research Laboratory, Mississippi State, MS*

*Robert G. Pratt, (601) 323-2230*

**A new type of screwworm trap** is part of an ARS effort to help the UN's Food and Agriculture Organization control this insect pest in the Caribbean region. Agency researchers will also develop an "artificial wound," an attractant that could be used with the trap to lure screwworm flies. And they'll develop a computer model to predict screwworm population densities, based on weather and other factors. The model will allow scientists to predict the number of screwworm cases in different areas, and to predict how quickly they will spread if reintroduced into an eradicated area. ARS researchers will also conduct genetic studies that will characterize screwworm populations in the Caribbean, Central and South America, to gain a better understanding of the pest's distribution patterns and to pinpoint the source of future outbreaks. An FAO-coordinated eradication program in the Caribbean could begin once the research projects are completed and international support is obtained, probably in 1995.

*National Program Staff, Beltsville, MD*

*Ralph Bram, (301) 504-5771*

*Food and Agriculture Organization of the United Nations, Rome, Italy*

*Moises Vargas-Teran, 57973977*

## Crop Production and Protection

**Pima S-7, a new commercial cotton variety** from ARS research, could boost growers' income—and the quality of fiber in fine-spun cotton fabrics. The new Pima variety produces stronger fiber than other Pimas used to make high-quality sheets, towels, sewing thread and high-fashion clothing. Pima S-7 eventually will supercede S-6, the current Pima variety in many areas of the "Pima belt" that extends from California's San Joaquin Valley to south-central Texas. Pima S-7 yielded 10 percent more fiber than S-6 at elevations below 2,500 feet, where 75 percent of Pima is grown. It also matured earlier, an advantage that could mean fewer applications of irrigation water and pesticide—as well as earlier harvesting in areas that get rainstorms in early fall. S-7 also is more tolerant of high air temperatures, which can cut yields. Growers have planted more acres of Pima cotton in recent years because it commands as much as 50 cents a pound more than upland cotton. Nearly all U.S. cotton is upland (*Gossypium hirsutum*). Pima (*G. barbadense*) is now grown on about 260,000 of the total 13 million acres of U.S. cotton. Pima S-7 was bred through 12 years of research by ARS scientists in cooperation with the Arizona Agricultural Experiment Station.

*Western Cotton Research Laboratory, Phoenix, AZ*

*Richard G. Percy, (602) 379-4221*

**Rice breeders can now get five new ARS breeding lines of rice** with more of an essential amino acid, lysine. The extra lysine, about 15 percent more than in a typical variety, makes rice a more nutritionally balanced protein. This would especially help people in developing countries where rice is the main—sometimes nearly the only—protein source. Current rice varieties grown in the world are low in lysine, but high-lysine ones bred from the new lines could be available in a few years. Scientists used a biotechnology method called inhibitor selection to identify rice cells with a natural genetic mutation that kept them making lysine longer than other cells. Then they regenerated and field tested whole plants from the high-lysine cells. About 95 percent of rice is consumed in the countries where it's grown. But the United States exported more than 40 percent of its rice in 1991, accounting for one-sixth of global exports.

*Plant Molecular Biology Lab, Beltsville, MD*

*Gideon Schaeffer, (301) 504-5342*

**Farmers in the central Great Plains can inadvertently reduce yields of winter wheat** by giving the crop too much nitrogen fertilizer—and being too optimistic about rainfall. From three years of tests, scientists discovered that applying more than 75 pounds of nitrogen fertilizer per acre can cut yields by up to 15 percent on non-irrigated fields. Yields fell even when the vital March-through-June rainfall was



near the normal 8.5 inches. Excess fertilizer produces larger plants that "optimistically" guzzle water early in the spring. But later on, these plants need more water than is available in about eight of 10 years. Result: Yields suffer. Scientists advise farmers to apply only about 50 pounds of nitrogen per acre, an amount that stimulates just enough growth to ensure high grain yield in years of average or near-average rainfall.

*Central Great Plains Research Station, Akron, CO*  
*David C. Nielsen, (303) 345-2259*

**A potential threat to U.S. citrus groves**—the brown citrus aphid—may be reduced by genetically altering citrus varieties to resist infection by the virus which the pest spreads. Not yet in the United States, the aphid is well established on citrus in Puerto Rico, the Dominican Republic and Haiti. This tropical pest efficiently spreads severe strains of citrus tristeza virus (CTV) as it feeds on trees. CTV has killed up to 500,000 sour orange-rooted citrus trees a year in Florida. CTV-resistant citrus varieties are being developed by ARS scientists. While these varieties are some years away, rootstocks that tolerate CTV are available. Scientists also are infecting trees with a mild strain of CTV that may protect them from more severe strains. Another possible defense: the use of parasites found in Asian countries to naturally control the aphid. ARS is working cooperatively with USDA's Animal and Plant Health Inspection Service, state departments of agriculture, universities and the citrus industry.

*U.S. Horticultural Research Laboratory, Orlando, FL*  
*Raymond K. Yokomi, (407) 897-7378*

**Yugoslavian honey bees that resist two damaging mites** are being released this spring by ARS. This is the first time the agency has ever released an insect as breeding stock. The imported bees are resistant to varroa and tracheal mites and could save beekeepers \$2 per colony in tracheal mite treatments. Domestic beekeepers now use chemicals to control the mites, which have caused extensive losses since they were discovered in the United States in the mid-1980s. The mites are considered a serious agricultural threat because bees pollinate billions of dollars worth of crops each year as they move among plants in search of nectar and pollen. The Yugoslavian stock is the subspecies *Apis mellifera carnica*. Against varroa mites, these bees are twice as resistant as susceptible domestic bees but would still require some chemicals to control severe outbreaks. Against tracheal mites, however, the imported stock has such high resistance that chemical controls for that pest probably would not be needed. ARS will release the breeding stock to several selected bee breeders, who will produce queens that will then be distributed to beekeepers. A Stock Release Panel, comprised of ARS and industry representatives, will choose specific breeders to maintain supplies of the bees.

*Honey Bee Breeding, Genetics, and Physiology Research*  
*Lab, Baton Rouge, LA*  
*Thomas Rinderer, (504) 766-6064*

**Tomorrow's orchids and gladiolus could be protected** against some of their worst virus enemies by a new reversed gene. Scientists took a piece of genetic material from a plant virus, reversed its coding sequence, and inserted the new gene in some experimental tobacco plants (*Nicotiana benthamiana*). In greenhouse tests, the reversed or antisense gene disarmed invading plant viruses in the plants. Some plants with the gene were immune to virus infection. Others became infected with typical mosaic symptoms like discoloration and stunting but soon recovered. Still others remained infected. It's the first time antisense technology—a form of genetic engineering where cells are instructed to do the opposite of what one of their genes is telling them to do—has been used successfully to create virus-resistant plants. The antisense gene was taken from bean yellow mosaic virus (BYMV) and will protect a whole range of ornamental flowers and some of the country's major economic crops like beans, peas and forage legumes. BYMV is one of about 150 viruses called potyviruses—the largest and most important group of crop diseases in the United States. Related viruses infect fruit trees like plum and similar techniques should work to save them from these viruses. Potyviruses cause an estimated five- to 20-percent loss in crops each year. The antisense gene might be ready in two to five years for breeders of floral and other crops to use.

*Florist and Nursery Crops Laboratory, Beltsville, MD*  
*John Hammond, (301) 504-5313*

**Blood-red, tabasco-like peppers** can't be missed on new ornamental plants introduced by ARS scientists. Plant foliage is a blend of purple, green and white. Three new breeding lines of ornamental peppers—developed from a diverse collection of Indian peppers—bear fruit that is edible, but very pungent. Two of the lines bear a solitary pepper or clusters of two or three, while the other produces 10 to 15 peppers in clusters. All three lines have been used successfully in trials as bedding plants in Illinois and Japan and as pot plants in California.

*Vegetable Laboratory, Beltsville, MD*  
*John R. Stommel, (301) 504-5583*  
*Florist and Nursery Crops Laboratory, Beltsville, MD*  
*Robert J. Griesbach, (301) 504-6574*

**A corn earworm female won't mate** until she knows there are nearby plants her offspring can eat. And when she does mate, the male passes along not only sperm but a protein that stops her from luring other males—and may also cause her to lose interest in sex until she lays her eggs. Those first-of-a-kind findings by ARS researchers could lead to environmentally friendly controls for the pest, which damages an estimated \$1.2 billion in crops each year.



Scientists say the earworm female won't release a sex attractant until she senses plant chemicals that tell her food is available for her offspring. Once she mates, the male earworm transmits what's called a pheromonostatic peptide (PSP), which appears to prevent her from releasing any more sex attractant until she's released her eggs. Scientists have identified the sequence of 57 amino acids that make up the PSP protein. Next, they'll synthesize the protein in the lab and test it to confirm its action. The ultimate goal: using a special insect-specific virus to transmit the male protein to corn earworm females to disrupt their mating.

*Insect Neurobiology and Hormone Lab, Beltsville, MD*  
Ashok K. Raina, (301) 504-9396

To help ward off a slow-moving but deadly disease of hazelnuts called Eastern filbert blight, ARS researchers screened 42 different lines of hazelnut plants. The plants included 33 commercial cultivars, and scientists identified four—Hall's Giant, Willamette, Casina and Tonda di Giffoni—with moderate resistance. The blight is caused by a fungus spread by wind and rain. It destroyed most commercial hazelnut orchards in Washington state two decades ago. Now it has spread to about six percent of the orchards in Oregon, where nearly all U.S. hazelnuts are grown. First symptoms are black pimple-like pustules on the tree's twigs. Sick trees can die after seven or eight years. Researchers recommend the more resistant varieties for planting new orchards or replacing dead or dying trees. They also found five hazelnut lines with excellent blight resistance. These are now candidates for future breeding work by scientists at Oregon State University in collaboration with ARS. The 1991 hazelnut crop, 25,000 tons, was valued at more than \$20 million.

*Horticultural Crops Research, Corvallis, OR*  
John N. Pinkerton, (503) 750-8784

Measuring the gases inside melons while they're ripening on the vine—a scientific first—will help assess new technologies for keeping fresh fruit tender and succulent. ARS scientists withdrew gas samples—carbon dioxide, oxygen and the ripening hormone, ethylene—from the cavity of cantaloupe and honeydew. As expected, ethylene gradually increased as the melons ripened. But there was a surprise concerning CO<sub>2</sub>. It has always been assumed that CO<sub>2</sub> rises sharply during ripening, but the ARS scientists found no CO<sub>2</sub> buildup until after the melons were harvested. Monitoring cavity gases in vine-ripening melons is a new tool for assessing technologies such as gene alterations to make melons ripen on demand, and shrink-wrap plastic or edible coatings to slow ripening and thus increase storage life.

*Crop Quality and Fruit Insects Research, Weslaco, TX*  
Krista C. Shellie, (210) 565-2647

When scientists crossbred a wild tomato from the Galapagos Islands with commercial varieties, they produced

plants with 25 percent more salt tolerance. Field trials of the new plants are underway. Scientists will select the best as forerunners of salt-tolerant commercial varieties. That would help tomato growers in the southwest including California, a state where half of its 8.6 million irrigated acres have some excess sodium chloride or other salts in the soil. Salt levels gradually build because when the roots of most plants take up water from irrigation, they don't take up the dissolved salts that arrived with the water. The salt accumulates around the roots, damaging and killing the plants.

*U.S. Salinity Laboratory, Riverside, CA*  
Michael C. Shannon, (714) 369-4834

A gene from the humble carrot could raise the soybean's nutritional—and economic—value. Soybeans are low in methionine, and more of this essential amino acid would increase the nutrient content of soy meal used in many foods and animal feeds. ARS scientists are uncovering more of the complex, gene-governed steps that cells follow to make amino acids. They study the carrot because its cells receive new genes and re-grow into seed-bearing plants fairly easily. Earlier, they isolated a carrot protein that, unlike any other yet found, has a dual function. Called aspartokinase-homoserine dehydrogenase protein, it makes two different enzymes when cells synthesize methionine and some other amino acids. After finding the sequence of the gene's building blocks, the scientists cloned or multiplied it. That will soon enable them to see if altered forms of the dual-function gene raise levels of methionine in carrot, other test plants and, eventually, soybeans. (PATENT APPLICATION 07/746,705)

*Plant Molecular Biology Lab, Beltsville, MD*  
Benjamin F. Matthews, (301) 504-5730

High-quality vegetable seeds might sprout even after 100 years of storage in the cold, dry conditions of ARS' National Seed Storage Laboratory, scientists now believe. Seeds and other plant tissue hold genetic material used to develop hardier, higher-yielding, more nutritious crop varieties for farmers and consumers. But scientists need data on storage life so they can determine when a given seed batch is likely to begin deteriorating. Before that happens, the seeds can be planted to obtain fresh supplies for the lab's valuable archives of plant germplasm. Most vegetable seeds had been thought to survive only 30 years or less. But recent ARS studies showed muskmelon, pea, okra and tomato seeds may live more than 100 years, and seeds of 15 other vegetable species can survive 50 to 60 years.

*National Seed Storage Laboratory, Fort Collins, CO*  
Eric E. Roos, (303) 495-3200

A new buffalograss, *Bison*, offers cattle producers all the growth and grazing benefits of the popular Texoka buffalograss variety, plus higher seed yields for use in additional plantings. In two years of field tests at three Oklahoma



sites, Bison and Texoka did not differ significantly in forage yields and quality, including dry matter digestibility, crude protein and fibers. However, Bison yielded 24 percent more live seed than Texoka. While Bison has not been tested outside Oklahoma, it is expected to grow well in the same geographic area as Texoka—roughly the southern half of the Great Plains. Bison was developed by ARS and Oklahoma State University. Production and marketing of Bison seed is licensed to the Johnston Seed Company in Enid, OK.

*South Central Family Farms Research Center,  
Booneville, AR*

*Timothy L. Springer, (501) 675-3834*

**Alfalfa with yellow flowers**—instead of the usual purple—could give a nutritional boost to cattle grazing on western rangelands. Without irrigation, traditional purple-flowered alfalfa has a hard time taking hold in semi-arid regions, and lacks drought tolerance. But seedlings of a new strain of yellow-flowered alfalfa grow just as vigorously on semi-arid lands as those of purple-flowered alfalfa. Scientists say improved seedling vigor and drought tolerance give yellow-flowered alfalfa plants a better chance of surviving on rangeland in the harsher climates of Montana and the Dakotas down through Colorado and western Kansas. They will provide samples of the new strain—as supplies allow—to plant breeders who want to develop new commercial varieties for ranchers. Alfalfa, a legume, has more protein than most grasses. And unlike grasses, it can use soil microorganisms to make its own nitrogen fertilizer.

*Crops Research Laboratory, Fort Collins, CO  
Charley E. Townsend, (303) 498-4231*

**Newly discovered strains of fourwing saltbush**—a nutritious native shrub for grazing in the arid west—reproduce by underground stems. This trait could lead to new commercial varieties that would bounce back faster after range fires and overgrazing, as well as boost the plant's usefulness in reclaiming stripmined areas. Until now, this highly palatable plant was thought to spread only by seed. But in New Mexico, ARS scientists found two populations of fourwing saltbush plants that also produce underground stems similar to those of strawberry plants. Scientists are confident that plant breeders or genetic engineers can incorporate the trait into new saltbush plants.

*Jornada Experimental Range, Las Cruces, NM  
Jerry R. Barrow, (505) 646-7015*

**Yellow nutsedge weeds were reduced by 90 percent in field studies** where sweetpotatoes and the weed were planted together. The reason: a chemical compound in sweetpotato roots inhibits growth of this weed, which causes problems in vegetable crops across the United States. This natural chemical defense—known as allelopathy—also was evident in greenhouse studies. Twelve weeks after being planted with sweetpotatoes, yellow

nutsedge growth was reduced by 50 percent. In lab studies, as little as 10 parts per million of the compound inhibited the growth of yellow nutsedge roots. The compound also inhibited velvetleaf and proso millet seed germination. Scientists are conducting further studies to identify the compound's chemical structure—which could lead to its development as a new, natural herbicide.

*U.S. Vegetable Lab, Charleston, SC*

*Howard F. Harrison Jr./Joseph K. Peterson, (803) 556-0840*

## Biological Control

**Tiny black wasps from Mexico banished boll weevils** from small test plots of cotton without use of insecticide. ARS scientists released thousands of the wasps, *Catolaccus grandis*, in test fields during the first eight weeks of cotton fruiting last summer. The wasps destroyed 98 percent of the young boll weevils, and by July these fields had three to 14 times more cotton bolls than plots unprotected by wasps. One weevil can destroy about 300 cotton flower buds by depositing an egg in each one. Weevil-infested buds fall to the ground without producing a boll. But *C. grandis* wasps seek out these buds in which to lay their own eggs. When a wasp larva hatches, it eats the boll weevil larva. This summer, researchers will conduct larger tests in Texas and, for the first time, Alabama. Boll weevils cost the U.S. cotton industry more than \$200 million each year.

*Subtropical Agricultural Research Lab, Weslaco, TX  
Edgar G. King/K.R. Summy/J.A. Morales-Ramos, (210) 565-2423*

## Human Nutrition

**The anti-cancer value of beta carotene and other carotenoids will be easier to assess** with a new database developed by ARS and National Cancer Institute researchers. Now available from NCI, it gives levels of the five most common carotenoids in 150 fruits and vegetables and more than 2,000 mixed foods containing fruits or vegetables. Carotenoids are a group of nearly 600 yellow, orange and red pigments that give foods like carrots, peaches, squash and tomatoes their distinctive colors. But green leafy vegetables also have lots of the compounds which are masked by the green color of chlorophyll. Researchers with ARS and NCI used these levels and the USDA survey recipes to determine the main contributors of the common carotenoids in the diets of women aged 19 to 50. Carrots, canteloupe and broccoli supply the most beta carotene, while carrots were the chief source of alpha carotene. Spinach, greens (collard, mustard and turnip), and broccoli supply the most lutein. And tomatoes and tomato products headed the list for lycopene. Oranges, tangerines and peaches were the top sources of beta-cryptoxanthin.



Nutrient Composition Laboratory, Beltsville, MD  
Gary R. Beecher/Joanne M. Holden, (301) 504-8356/  
8186

National Cancer Institute, Div. of Cancer Prevention  
and Control, Bethesda, MD

Michele Forman, (301) 496-8559

Another study shows that the semisolid, hydrogenated fats found in stick margarine are less friendly to the heart than the oils they come from. When a group of men and women with moderately high cholesterol switched from a typical U.S. diet to a cholesterol-lowering diet, their "bad" LDL cholesterol dropped an average 17 percent. And the protein associated with LDL—which some believe is a better measure than the cholesterol value itself—dropped 20 percent. But these values dropped only 10 percent each when researchers substituted the corn oil in the diet with corn oil margarine in stick form. The oil also resulted in a more favorable ratio of total cholesterol to HDL cholesterol—the kind that protects our arteries from damage—than did the stick margarine. Substituting stick margarine for corn oil increased the amount of saturated fat in the diet more than 20 percent and resulted in a 10-fold increase in trans fatty acids. Hydrogenated vegetable oils are found in crackers, cookies and many other products, including fried fast food. In addition to being semisolid, they are less prone to oxidation. But the findings of this and earlier studies by ARS and other groups should discourage their use in cholesterol-lowering diets.

Human Nutrition Research Center on Aging at Tufts,  
Boston, MA

Alice Lichtenstein, (617) 556-3127

Diets high in the sugar fructose significantly increased cholesterol levels—specifically the "bad" LDL cholesterol—in a small group of men. The five men also tended to have higher blood glucose levels while consuming nearly twice the level of fructose found in the average diet. They were involved in a study to see if excess dietary fructose would aggravate the signs of copper deficiency in people as it does in test animals. Copper is an integral part of several enzymes that act to defuse free radicals in the body, and fructose metabolism is known to generate free radicals. So the men alternated between diets low and adequate in copper containing either 20 percent fructose or an equivalent amount of starch for seven weeks each. The combination of low copper and excess fructose decreased some of the body's defenses against oxygen free radicals. But excess fructose alone increased serum cholesterol, regardless of the copper content of the diets. If the findings repeat in larger studies, it raises questions about the growing consumption of sugar (which is half fructose) and high-fructose corn syrups regularly added to processed foods and soft drinks. This may increase oxidative stress in the body.

Grand Forks Human Nutrition Research Center, Grand  
Forks, ND

Forrest H. Nielsen/David B. Milne, (701) 795-8456/8424

Tomorrow's physicians could use a simple blood test with an ARS-developed equation to predict whether their dieting patients are likely to be fast or slow at losing fat. Before that happens, however, the equation needs to be tested on more dieters, including overweight men and obese individuals of both sexes. When ready, the equation could help dieters set realistic goals, and assist health care professionals to better tailor each patient's weight loss plan. Researchers produced the equation by investigating a dozen biochemical factors during a three-month weight-loss study with 10 moderately overweight women volunteers. The equation is linked to one easy-to-measure indicator in the blood sample, that is, the amount of fatty acids that circulate in the blood while dieters burn up stored fat during exercise. Generally, the higher this amount, the more rapid the dieter's weight loss.

Bioenergetics Research, San Francisco, CA

Nancy L. Keim/Teresa F. Barbieri/Marta D. Van Loan,  
(415) 556-8821

It's as important to get adequate protein early in pregnancy as it is during the last trimester, according to a study of pigs. Since pigs and people are physiologically quite similar, the consequences of severely cutting the protein intake of pregnant swine suggests how such protein restriction might affect human fetal development. As expected, the sows whose protein intake was cut throughout pregnancy bore the smallest piglets compared to the control group. What was surprising was that piglets born to moms that were restricted during their first trimester had just as much development impairment as those whose moms were restricted during their last trimester. Protein restriction, however, did not appear to impair brain development in any of the groups.

Children's Nutrition Research Center, Houston, TX  
Wilson G. Pond, (713) 798-7127

Women who find themselves eating more after they ovulate may be replacing extra calories they burn to maintain basal metabolism. That's what a study of energy expenditure during the three phases of the menstrual cycle suggests. While sleeping, 12 women volunteers burned five to seven percent more calories between ovulation and menstruation than they did during and after menstruation. Such differences indicate the menstrual cycle is a significant contributor to variations in women's basal metabolism, and possibly how many calories they eat. As a result, researchers conducting energy expenditure studies in women will need to either measure all women at the same points in their respective cycles or account for differences



in basal metabolism.

*Energy and Protein Nutrition Lab, Beltsville, MD  
Juliette Howe, (301) 504-8181*

**High blood levels of the amino acid homocysteine**—now recognized as an independent risk factor for cardiovascular disease—may also contribute to the loss of brain function in older people. That's the implication of a preliminary study of depressed patients by researchers at ARS's Boston Center and a psychiatrist at nearby McLean Hospital. They wanted to know if high homocysteine levels are related to the loss of memory and the ability to learn that accompanies depression in the elderly. Homocysteine has the potential to damage the brain by two routes. First, depressed people have even more of the well established risk factors for cardiovascular disease than older people in general. Excess homocysteine would further damage blood vessels in the brain. Second, homocysteine is converted to an amino acid that stimulates brain cell receptors at normal levels but can cause the cells to self destruct at excess levels. Blood analyses of 27 depressed elderly patients showed that they had significantly higher plasma homocysteine levels and lower cognitive test scores—indicating a loss of brain function—than did 15 young depressed patients. Homocysteine was highest in the older patients with vascular disease. In those free of vascular disease, however, homocysteine levels were highest in the patients who scored lowest on cognitive tests. Homocysteine metabolism depends on several B vitamins—folic acid, B6 and B12. And treatment with these vitamins helps normalize blood levels. However further studies are needed to establish whether high homocysteine is a cause or an effect of certain forms of dementia in the elderly before any treatment could be considered.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Jacob Selhub, (617) 556-3191*

*Department of Psychiatry, University of Arizona,  
Tucson, AZ*

*Iris Bell, (602) 626-6509*

**More evidence that dietary copper helps protect body tissues from oxidation** comes from a study of rats' lungs. Researchers with ARS and the University of North Dakota compared the effects of eating a copper-deficient diet with breathing pressurized air having close to four times the normal oxygen content. Such high-oxygen, high-pressure chambers apply oxidative stress to lung tissues, allowing researchers to simulate the effects of long-term exposure to ozone and other atmospheric oxidants. The results: Rats fed a copper-deficient diet for five to six weeks suffered about the same damage to their respiratory membranes as the group that spent an hour in the chamber. The animals that got both a copper-deficient diet and the high-oxygen suffered major damage. Under the electron microscope,

their respiratory membranes were literally falling apart. People, like animals, use several copper-containing enzymes to deactivate the oxygen-containing compounds that cause damage. The findings suggest that U.S. diets—the majority of which contain less than adequate copper—may not be providing optimum protection against atmospheric oxidants. Adding oysters, liver, whole wheat, nuts and sunflower seeds to your diet will raise copper content.

*Grand Forks Human Nutrition Research Center, Grand  
Forks, ND*

*Jack T. Saari, (701) 795-8499*

## Scientific Information Systems

**Satellite images of Gulf Coast areas** could be used by marine resource managers to find, map and measure "communities" of black mangroves. In this country, these shrubs grow only along the Gulf Coast, mainly in Texas and Florida. Black mangroves help stabilize shorelines and supply excellent wildlife habitat. But their status is almost impossible to determine from the ground due to remote or inaccessible coastal terrain. Remote sensing data could be the answer, according to a cooperative experiment by ARS and the University of Texas' Pan American Coastal Studies Laboratory. Scientists obtained multi-spectral images from the French satellite SPOT and low-altitude airborne video. Computer analysis revealed that the satellite imagery accurately "captured" the extent and location of black mangrove communities on the lower Texas Gulf Coast near Laguna Atascosa Wildlife Refuge. Plus, airborne video showed potential for quickly assessing damage to mangrove communities by bad weather, such as severe freezes and tropical storms. The experiment supplies the first good baseline data for monitoring mangrove stands and the status of shoreline stabilization along bays and mouths of rivers.

*Remote Sensing Research, Weslaco, TX*

*James H. Everitt, (210) 969-4824*

**An improved Universal Soil Loss Equation**—the primary tool in conservation planning worldwide—is now complete. The equation—first developed by ARS scientists in 1958—was the result of a pioneering use of mathematics to solve an agricultural problem. This fall, Soil Conservation Service personnel will begin using the computerized RUSLE (Revised Universal Soil Loss Equation) to supply farmers with more accurate information on how to reduce soil erosion by water. The RUSLE more accurately reflects annual rainfall, seasonal changes such as freezing and thawing, and other factors.

*Southwest Watershed Research, Tucson, AZ*

*Kenneth G. Renard, (602) 670-6481*

**A new computer model, Opus**, is available to help farm advisors, managers and scientists select the best practices



for keeping farm pesticides and fertilizer out of water supplies. This state-of-the-art model is the fruit of years of research and development. It's designed to help determine how much of dissolved agrichemicals will be transported to ground and surface water supplies under specific farming methods. It does this by simulating water movement on and through various soil types, plant growth, water use, erosion, runoff and chemical movement. Older models are less accurate and comprehensive. Opus comes with user and documentation manuals and can be obtained from the scientists. It requires an IBM-compatible computer and runs best if the computer has a 386 or faster microprocessor and a math co-processor.

*Water Management Research Unit, Fort Collins, CO  
Roger E. Smith, (303) 491-8263*

**Dairy farmers can get help on management decisions** from DAFOSYM, an ARS-developed computer model that simulates dairy farm operations. As an example of how DAFOSYM can be used, researchers entered data on two western New York dairy farms to find a cost-efficient way to store silage. Answer: A type of silo known as a top-unloading, stave tower silo was the most economical storage structure. So far, 150 copies of DAFOSYM have been distributed free of charge to farmers, farm consultants, cooperative extension agents and other researchers. To obtain DAFOSYM, write to C. Alan Rotz, USDA-ARS, 206 Farrall Hall, Michigan State University, East Lansing, MI 48824.

*U.S. Dairy Forage Research, Madison, WI  
Richard E. Muck, (608) 264-5245  
Fruit and Vegetable Harvesting Research, East Lansing, MI  
C. Alan Rotz, (517) 353-1758*

### **Soil, Water and Air**

**A two-year study of water, soil, sediment and fish** showed little or no accumulation of old and new pesticides within a 51,000-acre agricultural watershed. The Otoucalofa Creek watershed in Mississippi includes drainage from 24,100 acres of forest, 14,826 acres of crops, 12,108 acres of pasture and the small town of Water Valley. Average levels of metals were largest in soil and sediment, while the largest average levels of insecticides were in fish. Levels of currently used insecticides were consistently low or undetectable. Arsenic and mercury averaged 0.67 and 0.31 parts per million (ppm), respectively, in soils and about 0.25 and 0.03 ppm in sediments but were lower in fish. DDT and its metabolites averaged about 118 parts per billion (ppb) in fish and 1.9 ppb in sediment with undetectable levels in soil. Water samples taken during normal flow had low-to-undetectable levels of both metals and insecticides. Concentrations were much higher when sampled during storms but still did not approach dangerous levels

based on the Environmental Protection Agency standards. Since arsenic, a major component of some herbicides, is the only persistent contaminant still being applied to farmland, concentrations should steadily decline. Besides helping scientists who are studying pesticide movement in rural, mixed cover watersheds, this information should help farmers choose the right pesticide for their needs and understand the importance of curtailing runoff from their fields.

*National Sedimentation Laboratory, Oxford, MS  
Scott Knight, (601) 232-2934*

**Limestone sinkholes funnel livestock waste and other pollutants into cave streams** that feed surface springs and wells used for drinking water. Sinkholes are characteristic of limestone bedrock areas such as those found in the Midwest, Appalachia and Florida. About a third of Appalachia's agricultural production comes from the 18 percent of the land over this type of karst formation. As part of the President's Water Quality Initiative, ARS scientists have been sampling West Virginia's cave springs and streams as well as a surface stream weekly for the past two years. One cave stream system had a high nitrate level of 64 parts per million (ppm) and an excessive fecal coliform bacteria count of 28,588 colonies per milliliter. This stream receives flow from a sinkhole next to a feedlot. Nitrate levels in all other waters tested were within Environmental Protection Agency guidelines of 45 ppm. Levels of the herbicide atrazine were well within EPA guidelines for all waters tested.

*Appalachian Soil and Water Conservation Laboratory, Beckley, WV  
Doug G. Boyer, (304) 252-6426*

**Placing fertilizers and other agrichemicals on the downwind side of crop rows** in ridge tillage farming systems would expose them to less rainfall, an ARS study shows. This should lessen the chance of the chemicals being leached down to groundwater. Ridge-till farmers plant crops on built-up seedbeds or ridges, with valleys between ridges. In the study of corn and soybeans conducted during the 1992 growing season, scientists found that the least rain fell on the ridge shoulder on the leeward side, making it the driest part of the ridge. Scientists noted rainfall differences on the soil surface of up to 1.5 inches per event depending on wind speed and direction. Results indicate that laying out rows so that prevailing winds cross them at a 45 degree angle rather than parallel or perpendicular to the rows will make this region even drier on average. This season, the effect of wind direction on the actual movement of fertilizer and herbicides will be studied.

*Soil and Water Management Unit, St. Paul, MN  
Robert H. Dowdy, (612) 625-7058*



# Quarterly Report

of Selected Research Projects April 1 to June 30, 1993

United States  
Department of  
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Agricultural  
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## Into the Marketplace

### Patent Licenses

...With **Animal Biotechnology Cambridge Ltd. of Cambridge, England**, to commercialize ARS-patented technology for farmers to predetermine the gender of their livestock's offspring. Live sperm cells treated with fluorescent dye are passed through a cell sorter. The cells flow single file past a laser beam and are collected in separate tubes based on the amount of light they emit. Sperm having the X or female-determining chromosome give off more fluorescent light because of their greater DNA content. Sorted X or Y sperm are used to fertilize cow eggs in test tubes—called in vitro fertilization. Developing embryos are then transferred to cows. The company and ARS conducted the first tests of the technology and successfully produced the world's first calves of predetermined sex—three male and three female dairy calves. Previously, ARS scientists had produced offspring from swine, sheep and rabbits of predetermined sex. Dairy farmers could use the method to obtain more female calves to improve their herds. The technology also could be used to provide beef

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

Items marked with the word **PATENT** are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.

cattle ranchers with more males—which grow faster than females.

*ARS Contact: Lawrence A. Johnson, Germplasm and Gamete Physiology Laboratory, Beltsville, MD, (301) 504-8545*

...To **Difco Inc. of Detroit, MI**, to manufacture an improved pre-enrichment medium for the detection of salmonella—a major cause of food poisoning. The new medium offers a seven percent improvement in salmonella detection over currently used pre-enrichment media. That means cooked meat products are less likely to contain salmonella upon leaving the factory. Federal law requires that ready-to-eat meat products such as hot dogs and cold cuts have no salmonella bacteria when they leave the processing plant. A pre-enrichment medium is used to “rehabilitate” bacteria injured but not killed by heating or other bacteriocidal treatments. This medium allows very small quantities of the bacteria, undetectable by routine culture methods, to multiply to sufficient numbers to be detected by standard tests for their presence. The new medium can also be used to help detect salmonella on food processing equipment and in raw meat. Before being placed on the market, it will undergo rigorous testing by 10 independent laboratories. (PATENT 5,145,786)

*ARS Contact: J.S. Bailey, Poultry Microbiological Safety Research, Athens, GA, (706) 546-3356*

### Cooperative Research and Development Agreements

...With **Eli Lilly and Company of Indianapolis, IN**, to study the experimental drug ractopamine in livestock and poultry. Studies already have shown that when swine or turkeys consume rations containing ractopamine, less feed is needed to produce meat, and the meat has less fat and more protein. Scientists will focus on how ractopamine and related compounds are metabolized in the animals' bodies. A thorough understanding of the biochemical mechanisms involved is needed to help ensure safe use of ractopamine in animals raised for human consumption.

*ARS Contact: Gaylord D. Paulson, Animal Metabolism-Agricultural Chemicals Research, Fargo, ND, (701) 239-1238*

## Crop Production and Protection

**Soybeans from backyard gardens** in southern China have genes for flood-tolerance that are missing in U.S. and Chinese commercial varieties. American soybean's



ancestors came from China. An ARS scientist who found the "backyard soybeans" is close to locating the genes that enabled the plants to survive China's greatest flood in a century in May 1990. A gene mapping technique called random amplified polymorphic DNA is being used to study the Chinese plants. A "map" of the genes will help plant breeders to develop flood-hardy soybeans—a critical trait for areas vulnerable to floodwaters such as in the Midwest. Severe flooding can cause 10 percent or higher yield losses of soybeans and corn. Also, ARS research will aid soybean geneticists seeking to map genes controlling other desirable traits.

*Soil Drainage Research, Columbus, OH*  
Tara T. Van Toai, (614) 292-9806

One of the genes that may be responsible for flood tolerance in corn has been isolated by the ARS scientist working on the same trait for soybeans. As a first step in the gene search, the growth inhibitor ABA was sprayed on corn seedlings. ABA caused the treated seedlings to produce four times more peroxidase enzyme, which seems to give plants flood protection. Even after 48 hours of submersion, treated plants had sturdier roots. ABA-treated corn had an 87 percent survival rate after being submerged in water for 24 hours, compared to about eight percent for untreated corn.

*Soil Drainage Research, Columbus, OH*  
Tara T. Van Toai, (614) 292-9806

A fragment snipped from a corn gene is helping biotechnologists worldwide to simplify their genetic engineering experiments with corn, wheat, rice, barley, and sugarcane. These cereal or grass crops (monocots) have typically been the most difficult to coax into accepting new genes. The gene fragment, known as the *ubiquitin-1* promoter, speeds the rate at which plants generate the signal from a newly inserted gene. The promoter is nearly 100 times stronger in sugarcane bioengineering experiments, for example, than the 35S promoter—the one most commonly used in plant genetic engineering today. Typically, scientists fuse the *ubiquitin-1* promoter to a marker gene. The marker gene signals whether a lab technique for inserting new genes into these recalcitrant crops is succeeding. With a weaker promoter, the signal is sometimes undetectable in some cells. Scientists also can attach the promoter to other genes, such as those that make plants resistant to insect or disease pests. Researchers at the ARS/University of California Plant Gene Expression Center are making the promoter available to agribusiness and research institutions; Mycogen Corporation's Agrigenetics Division, which funded part of the research, is seeking a patent.

*ARS/University of California Plant Gene Expression Center, Albany, CA*  
Peter H. Quail, (510) 559-5900  
George Mason University, Fairfax, VA  
Alan H. Christensen, (703) 993-1025

Natural compounds that kill crop-damaging whiteflies have been identified as a group of sugar esters that are environmentally safe for use as insecticides. ARS scientists found the compounds on the surface of leaves of *Nicotiana glauca*, a wild relative of tobacco. The esters are produced by leaf hairs on the plant. Since the plant normally produces only a small amount of these compounds, ARS scientists plan to use classic genetic breeding to grow plants that produce greater amounts of the compounds. The scientists have applied for a patent on the compounds.

*Horticultural Crops Quality Laboratory, Beltsville, MD*  
J. George Buta, (301) 504-5598  
*Florist and Nursery Crops Laboratory, Beltsville, MD*  
John W. Neal, Jr., (301) 504-9159

Breeders could make Mississippi cotton far less hospitable to root-knot nematodes by using an ARS breeding line, M 315. The nematode—a tiny, worm-like animal—damages roots. That reduces the plant's ability to take up water and nutrients and makes them more vulnerable to invasion by soil-borne wilt disease. Together, nematodes and disease reduce cotton yields more than 10 percent. When ARS and Mississippi State University released M 315 five years ago, growers preferred higher-yielding varieties. On the basis of new greenhouse studies, however, breeders may take another look at M 315. It could be a forerunner to new varieties with both high yield and powerful nematode resistance. The new studies compared M 315's nematode susceptibility with that of 22 commercial varieties grown in Mississippi. Using cotton plants grown in pots, scientists inoculated the soil in each pot with 7,500 nematode eggs. After 40 days the number of eggs in the M 315 pots had fallen almost 70 percent, while commercial varieties housed 125,000 to 250,000 eggs. Scientists developed M 315 by crossing a breeding line, Auburn 364, with a commercial variety, Deltapine 61.

*Crop Science Research Lab, Mississippi State, MS*  
Johnie N. Jenkins, (601) 323-2230

Several naturally occurring bacteria found in potato fields may replace synthetic chemicals to treat a potato disease known as dry rot. Dry rot is caused by a fungus, *Fusarium sambucinum*, that infects potatoes through wounds in the skins. Potatoes become infected in the field and in storage. The disease causes dry, grayish blemishes on the potato, and can affect up to 60 percent of the potatoes harvested from a given field. When treated with the naturally occurring bacteria, potatoes have fewer affected areas, and in some cases the blemishes are totally absent. The bacteria are not harmful if eaten by people or animals. Growers for 20 years have used a chemical to control the disease, but the fungus showed complete resistance to the chemical in 75 percent of the field samples tested. (PATENT APPLICATION 08/068,872)

*Fermentation Biochemistry Research, Peoria, IL*  
David A. Schisler, (309) 681-6284



**Tomatoes and potatoes**, two of the world's most popular vegetables, come from plants that are so closely related they should be in the same genus. That was the finding of ARS and university researchers who studied genetic material in both vegetables. Potatoes are now in the *Solanum* genus—and so were tomatoes in the mid-18th century. But later, an English botanist moved them to the *Lycopersicon* genus—and scientists have debated the issue since. Now researchers say tomatoes should be moved back to *Solanum*, based on an examination of genetic material, called DNA, from chloroplasts of 21 *Solanum* species, three *Lycopersicon* species, and three other related genera. They compared the genetic material among the various species—allowing them to establish that potatoes and tomatoes are “sister” plants. They also based their finding on morphological traits such as the flowers and overall plant form.

*Vegetable Crops Research, Madison, WI*

*David M. Spooner, (608) 262-0159*

**Genes from an ancient sunflower** variety in Arizona could be incorporated into North Dakota sunflowers to cut losses caused by rust disease. On the Northern Great Plains, most commercial sunflower hybrids are susceptible to new races of rust. Now the variety developed by early-day Havasupai Indians is being used to breed new resistant varieties. Tests have shown the Havasupai variety resists exotic races of the rust pathogen from Argentina, Australia, China, India and South Africa. These results have prompted a concentrated study on all Native American varieties in ARS's North Central Plant Introduction Station, Ames, IA, for resistance to several disease and insect pests as well as for other useful traits. It has also spurred interest in collecting additional Native American sunflower varieties. Many Native American tribes unfortunately no longer raise sunflowers or have abandoned traditional varieties in favor of commercial hybrids.

*Oilseeds Research, Fargo, ND*

*Thomas J. Guyla, (701) 239-1316*

**A new eating peach bred and released** by ARS scientists resists bacterial spot, a disease that commonly attacks peaches. The new peach, dubbed Flameprince, matures in August and measures two-and-a-half to three inches in diameter, with a golden yellow background color that makes it easy to judge ripeness for picking. The bright red, freestone fruit is very firm, with excellent quality and texture. Flameprince has been field tested in Alabama and Texas, has produced good crops in Georgia for 10 years and is suggested for trial in the middle chilling zones of the southeastern United States. The peaches don't drop prematurely as late peaches can, but soften slowly on the tree. Trees will be available from nurseries in winter, 1993-1994.

*Southeastern Fruit and Tree Nut Research, Byron, GA*

*William R. Okie, (912) 956-5656*

**A single dominant gene** has been identified that helps cantaloupes resist the ravages of watermelon mosaic virus (WMV), one of the most serious viral diseases affecting melon production in the United States. The gene can be transferred through plant breeding to economically important melon varieties. The gene does not make cantaloupes immune to WMV, but plants carrying this gene recover from initial symptoms, and yield and quality of their fruit are significantly better than that of currently available susceptible varieties. Collaborative studies of the gene with Cornell University researchers also resulted in development of a quick test that will allow researchers to pinpoint WMV-resistant plants at an early phase in breeding programs—saving time and effort in the search for high-yielding, virus-resistant melon varieties.

*Plant Protection Research, Ithaca, NY*

*Stewart M. Gray, (607) 255-7844*

**New crosses of highbush and rabbiteye blueberries** succeed where earlier hybrids failed. Using newly created highbush lines, ARS scientists produced new hybrids that should grow more vigorously and produce more berries than earlier ones. These new hybrids—available as breeding lines—have some characteristics of both species. A limited quantity of germplasm is available to breeders who are trying to develop higher-quality blueberries. Highbush blueberries, grown mainly in the Northeast, ripen earlier and have thinner skins and smaller seeds than the rabbiteye. The rabbiteye produces firmer blueberries with smaller stem scars and adapts better to the more alkaline soil, heat and humidity of the southeastern United States.

*Blueberry and Cranberry Research Lab, Chatsworth, NJ*

*Mark K. Ehlenfeldt, (609) 726-1590*

**Broccoli and cabbage** could provide extra income on erodible land where agriculture is often limited to grasses and the animals that eat them. ARS researchers skipped the usual planting beds for the two crops and grew them in no-till soil that retained more moisture as the plants grew. In field tests, broccoli and cabbage seedlings were transplanted in early September into pastureland where native grasses had been temporarily thwarted with herbicide to eliminate early-season competition for moisture for the vegetable crops. Two no-till treatments were used—soil chiseled approximately 18 inches deep, versus strips of soil rototilled to a depth of about four inches. These were compared with soil disked conventionally and formed into planting beds about eight inches high. Broccoli and cabbage yields in the rototilled strips were similar to those in the conventional planting beds, and were higher than in the deeply chiseled soil.

*South Central Family Farms Research, Booneville, AR*

*Donald J. Makus, (501) 675-3834*

**A gene from citrus** has been isolated for the first time—an important step toward being able to select and insert into



citrus the specific genes that control desirable traits such as cold hardiness. Cold hardiness and other stress-related traits in citrus are not well understood and are therefore difficult to genetically engineer. But ARS scientists isolated a gene from trifoliate orange, a cold-hardy citrus that bears bitter inedible fruit but serves as a good rootstock for sweet orange. The technology to regenerate a complete citrus tree from one cell is available, but that produces a replica, not a genetically different plant. ARS scientists are using electrical shock to create tiny holes in citrus cell membranes through which they can insert new genetic material—i.e., DNA. The holes reseal and the cells function normally with the foreign DNA inside. Specialized cell lines for all the major types of sweet orange grown in Florida have been developed and are being routinely used in research. Other expected genetic targets are genes that improve juice color and increase plant proteins that defend against disease and insect attack.

*U.S. Horticultural Research Laboratory, Orlando, FL*  
Randall P. Niedz, (407) 897-7300

A new soybean variety, "Vernal," lets Southern farmers plant earlier without worrying about shorter days. Soybeans grow and mature in response to the amount of daylight they receive. Ideally, days should be 14 1/2 hours or longer when plants emerge. Vernal's delayed flowering characteristic permits good growth despite shorter days. In field tests, when Vernal was planted in mid-May at Stoneville, MS, the beans were ready for harvest in mid-October and averaged 45 bushels per acre. When planting was moved up to mid-April, the beans matured in late September and averaged 55 bushels per acre.

*Soybean Production Research, Stoneville, MS*  
Edgar E. Hartwig, (601) 686-2311

Five of seven genes known to control whether soybean plants resist or fall prey to a disease called phytophthora root rot have been mapped by ARS scientists. Knowing the location of these five genes on the soybean chromosomes can help speed the breeding or genetic engineering of plants that resist the rot disease. Phytophthora root rot attacks the soybean plant's vascular system and eventually kills the plant. Growers can lose thousands of dollars in reduced yields. Additional genetic mapping studies of soybeans are searching for the location of genes responsible for protein and oil content.

*Field Crops Research, Ames, IA*  
Randy C. Shoemaker, (515) 294-6233

Tapping the natural potential of cover crops to repel weeds could let soybean farmers cut herbicide use and tillage without sacrificing weed control or yields. In field tests, a cover crop of hybrid sorghum-sudangrass was killed with the chemical glyphosate prior to planting soybeans on the same soil. On some plots, the cover was killed two

weeks before the soybeans were planted; on other plots, the cover was killed either a week before the bean planting, or immediately before planting. No additional weed control measures were used on the plots after the soybeans were planted. For comparison, two other plots had no cover crop prior to bean planting; one plot was weeded by hand as the soybean plants grew, and another plot was not weeded at all. Sixty days after the soybeans were planted, weed biomass was 98 percent less on the plots where the cover crop was killed just before soybean planting, compared with the non-weeded plot with no sorghum-sudangrass cover. Weeds were reduced 95 percent on plots where the cover crop had been killed one week before bean planting, and 81 percent on plots where the cover had been killed two weeks before planting. Bean yields for the cover crop plots treated one week before planting or at planting were only reduced by up to seven percent compared to the weeded plot with no cover crop. However, yields in the cover crop plots treated two weeks before planting were reduced by 45 percent, possibly due to poor weed control, allelopathy from the sorghum-sudangrass, or other unknown reasons.

*Weed Biology and Management Research,*  
Stoneville, MS  
Reid J. Smeda, (601) 686-5222

Only a quarter of the usual dose of the herbicide bentazon was needed to control common cocklebur in soybean field tests when the soil between the bean rows was tilled. ARS researchers tilled twice between the rows after a single bentazon application of one-quarter pound per acre. The result: 90 percent of the cocklebur was gone. Usually, a half-pound per acre is applied two times to knock out that percentage of cocklebur. Farmers spend at least \$100 million annually to combat common cocklebur, a bushy, prickly invader that reduces soybean yields more than any other weed.

*Plant Science Research, St. Paul, MN*  
Douglas D. Buhler, (612) 625-6719

A new ARS test drastically shortens the time it takes to detect foreign disease-causing viroids such as apple scar skin viroid (ASSVd) that can devastate U.S. crops. The current screening test for ASSVd requires growing new trees coming into the United States for three to five years to check for symptoms on the fruit. The presence of other pathogens may mask or interfere with viroid symptoms. The new test makes it possible to grow young trees in a greenhouse for just two months. Then a tissue blot made directly from the plant's sap takes about a day to analyze for ASSVd. The same test—using different probes—detects potato spindle tuber viroid, which can cause severe stunting and cracking of potato tubers.

*National Germplasm Resources Laboratory,*  
Beltsville, MD  
Ed Podleckis/Ahmed Hadidi, (301) 504-6209/6460



**Just six weeks of barnyardgrass infestation** is enough to reduce rice crop yields. Competition from the weed causes mounting yield losses as the growing season passes, even when barnyardgrass numbers are as low as one plant per five square feet. Hardest hit by the weed are semidwarf rices such as the popular Lemont variety versus more conventional varieties such as Newbonnet. In field tests, Lemont yields dropped 72 percent when 20 barnyardgrass plants per five square feet went unchecked for 130 days after rice plants had emerged from the soil. By comparison, Newbonnet yields fell 47 percent at the same level of infestation. Even with only one barnyardgrass plant per five square feet, Lemont lost 11 percent in yields after 63 days and 15 percent after 130 days, but Newbonnet yields weren't hurt at those low levels of infestation. Heavy infestations of barnyardgrass also attract stink bugs that damage the rice.

*Rice Production and Weed Control, Stuttgart, AR*  
Roy J. Smith Jr., (501) 673-2661

**Woody plants like mesquite**—already at home on dry southwestern rangeland—appear to get an extra shot of growth from higher levels of carbon dioxide in the air. Such plants possess a metabolism that allows them to use additional CO<sub>2</sub> to grow faster. Native grasses in the Southwest generally lack this metabolism. Atmospheric carbon dioxide over the past 200 years has risen from 270 parts per million to the current 350 parts per million. In tests, both mesquite and a native grass called little bluestem were grown in CO<sub>2</sub> concentrations that spanned atmospheric levels from the last ice age to the present. The higher CO<sub>2</sub> not only gave the mesquite a bigger boost in growth, but also reduced the amount of water and nitrogen that mesquite needed to grow.

*Grassland, Soil and Water Research, Temple, TX*  
H. Wayne Polley, (817) 770-6629

**When fresh irrigation water is in short supply** or too costly, California almond growers may be forced to rely on salty water instead. Results of a study by ARS and University of California scientists will help growers estimate how much of the tree's water needs can be met with salty irrigation water without harming nut yield and tree health. When scientists irrigated young almond trees with moderately salty well-water for seven summers, growth was 20 percent less and nut yield 30 to 50 percent less than the average expected from trees grown elsewhere with high-quality irrigation water.

*Water Management Research Laboratory, Fresno, CA*  
Robert B. Hutmacher, (209) 453-3100

## New and Improved Products

**A method for excluding salmonella**, a major food poisoning bacterium, from the intestines of hatching chicks has

been patented by ARS scientists. Researchers placed harmless chicken-intestinal bacteria, previously grown in laboratory cultures, into developing eggs three days before hatching. The purpose was to colonize the hatching chick's intestines, which do not contain bacteria, with harmless bacteria and thus "competitively exclude" salmonella—meaning there wouldn't be enough room for the salmonella bacteria to gain a toe hold. In tests, after hatching, birds from treated and untreated eggs were fed with salmonella bacteria. The treated birds were resistant to the salmonella—even when given 10 million of the bacteria, only half became infected, while all the untreated birds became infected. Embrex Inc., Research Triangle Park, NC, has been granted a license by ARS to commercially develop the competitive exclusion technique for salmonella. (PATENT 5,206,015)

*Poultry Microbiological Safety Research, Athens, GA*  
J. Stan Bailey, (706) 546-3356

**Compounds found in everyday foods** could inhibit the growth of bacteria linked to food-borne illnesses. ARS laboratory tests found a naturally occurring preservative called nisin that suppressed the growth of *E. coli* 0157:H7 and *Salmonella typhimurium* when combined with common food additives. Among the additives are EDTA, sodium hexametaphosphate, citric acid, or lactic acid. In the tests, 70 million each of *E. coli* and *Salmonella* bacteria were treated with the mixtures for either 60 minutes at 99 degrees F, or 30 minutes at 41 degrees F. After either treatment, only 100 to 10,000 *S. typhimurium* and 50 to 1,000 *E. coli* cells remained. ARS scientists are developing the proper mixture of nisin and other compounds to reduce these and other bacteria that can contaminate red meat.

*Meats Research Unit, Clay Center, NE*  
Catherine Nettles Cutter/Greg Siragusa, (402) 762-4100

**Taxol**, approved last year by the Food and Drug Administration as a drug for ovarian cancer, could be produced from Maine's yew bushes. A database developed by ARS scientists revealed that needles of the bush, *Taxus canadensis*, from Maine contain five times more taxol than found in the bark of the western yew trees, *T. brevifolia*. Currently, western yews must be destroyed for their bark to extract this chemical, whereas the Maine bushes produce new needles each year. Taxol is also showing promise for the treatment of other types of cancer that cause the death of nearly 300,000 Americans yearly. As a by-product of the extraction process, energy alcohol could be produced along with several other useful chemicals.

*National Germplasm Resources Laboratory,*  
Beltsville, MD  
James Duke, (301) 504-5419



**Detecting colon cancer in humans** could become easier using a gene cloned from *Streptococcus bovis*, a bacterium normally found in the stomach of cows and sheep. The gene may act as a probe to seek out and bind to strains of *S. bovis* that are found in humans, although rarely. Medical research has linked increased levels of *S. bovis* with colon cancer. Tests indicate the probe will bind to various strains of the bacteria in the human colon or animal rumen. ARS scientists made their discovery while studying the role of the *S. bovis* gene in producing an enzyme that allows the breakdown of starches to simpler sugars.

*Fermentation Biochemistry Research, Peoria, IL*  
Terence R. Whitehead, (309) 681-6272

**Newly-designed protein products** for foods, feeds, and industrial uses could be made from soybeans. ARS researchers developed a method to assess what happens to soy proteins and other components during heat processing. Industry now uses high temperatures and low moisture conditions for processes such as roasting, frying, and extrusion cooking. The model system demonstrates to soy processors what specific changes occur in soy proteins when cooked at lower temperatures and under different moisture conditions. Once it is known exactly how much heat is needed then proteins can be designed with specific functions. The benefit to industry is that it's possible to cut time and energy costs by turning down the heat.

*Biopolymer Research, Peoria, IL*  
David J. Sessa, (309) 685-4011

**Quality control checks for soybean processing** should keep a closer watch on natural compounds called phospholipids to guard against damaging the oil's flavor and stability. These compounds can't always be removed in the normal degumming process used by the soybean processing industry. But researchers have discovered that a procedure called reverse phase high-performance liquid chromatography (HPLC) lets laboratory technicians track more closely the amounts of phospholipids in the oil, as well as identifying specific ones present.

*Food Quality and Safety Research, Peoria, IL*  
Timothy L. Mounts/Sharon Abidi, (309) 685-4011

**Soybeans are being genetically modified** to contain fewer indigestible sugars, boosting the beans' nutritional value as feed for chickens. Soybeans contain up to six percent of indigestible sugars called raffinose sugars, which have a laxative effect on chickens. Researchers isolated a small section of a gene in zucchini to be used to isolate the soybean gene that prompts production of galactinol synthase, an enzyme needed to make raffinose sugars. Using a biotechnology technique called "antisense," they can prevent the gene from making the enzyme. Previous studies by other researchers showed that removing raffinose sugars from chicken feed increased the usable energy that

the birds derive from soymeal in the feed.

*Phytoproducts Research, Peoria, IL*  
Tsung Min Kuo, (309) 685-4011

**Catfish processors can more effectively detect** compounds that cause rancidity in frozen fillets by sampling only the dark meat instead of the whole fillet. Oxygen, seeping into fillets during storage, breaks down fat to make compounds called aldehydes. But ARS and Mississippi State University scientists found more aldehydes in dark meat, which contains more fat and more iron and copper—catalysts for fat breakdown—than white meat. In the scientists' tests, using gas chromatography (GC) or "TBA" analyses of aldehydes in dark meat accounted for over 90 percent of rancid flavors that a taste panel detected in whole fillets. The fact that dark meat represents only 10 percent of the whole fillet explains why GC or "TBA" analysis of aldehydes in the whole fillet correlates poorly with rancidity scores given by the taste panels on which most processors rely. Now, processors can use aldehyde analyses for evaluating how well antioxidants, new packaging techniques or handling practices delay rancidity and therefore prolong shelf life.

*ARS Aquaculture Research Project, Tishomingo, OK*  
Donald W. Freeman, (405) 384-5221

**Improving the taste of roasted peanuts** is just around the corner, thanks to ARS flavor chemists. They identified and ranked the dozen natural compounds most important to the aroma of fresh-roasted peanuts. Aroma is crucial to flavor, and the scientists used readings from lab instruments and the sensitive noses of volunteer "aroma panelists" to rate the compounds. Two of the compounds weren't previously known to occur in peanuts. Peanut processors can use the ratings to enrich the flavor of roasted peanuts and other products—especially lowered-calorie peanuts, since some aroma compounds are lost when peanuts' natural oil, high in calories, is removed. Plant breeders can also check the aroma scores in screening potential new peanut varieties for flavor.

*Cereal Product Utilization Research, Albany, CA*  
Gary R. Takeoka/Ron G. Buttery, (510) 559-5668

**Some natural aroma compounds** of fresh raspberries and strawberries when incorporated into packaging materials could help the berries stay fresh at least a week longer by stifling disease-causing fungi. Lab studies were run on 15 major volatile compounds that partially make up the natural aroma of the berries. ARS scientists found five that each inhibited the growth of three fungi: *Alternaria alternata*, *Botrytis cinerea* and *Colletotrichum gloeosporioides*. The most promising of the volatiles, 2-nonanone, could cost less than a penny for enough to treat a quart of berries. The 2-nonanone could be encapsulated in cornstarch for slow release to the berries in partially ventilated



packaging. Additional research is needed before this treatment can be commercialized.

*Bioactive Constituents Research, Peoria, IL*  
Steven F. Vaughn, (309) 681-6344

**Controlling the amount of moisture** in packaged meat and cheese snacks ensures the safety of these foods. *Staphylococcus aureus*, a pathogenic foodborne bacterium, can jeopardize the safety of meat and cheese products that have been preserved by being semi-dried. ARS scientists have helped establish the proper balance of moisture needed to prevent bacterial growth on both the meat and the cheese. These research results will be used for developing federal guidelines for safe processing of these shelf-stable, convenient snacks.

*Microbial Food Safety Research, Philadelphia, PA*  
Kathleen T. Rajkowski, (215) 233-6620

**Grapefruit sections packed in syrup** were up to 86 percent firmer—with no adverse effect on flavor—when a natural substance called calcium lactate was added to the fruit. Calcium lactate is an approved, widely used food additive. In tests, researchers weren't sure whether the added calcium actually increased firmness of the fruit sections or reduced softness caused by the heat of the canning process. A combination of both could have produced the uniform firmness seen in the grapefruit sections. Typically, grapefruit sections packed in juice and syrup can become soft. As a result, the fruit fails to meet USDA quality standards requiring that 65 percent of canned sections be whole or almost whole. Early-season grapefruit produces the firmest fruit sections, but immature fruit often has a bitter taste. Mature fruit is softer and tastes better, but its sections are highly susceptible to membrane breakage, and the canning process causes further loss of firmness.

*U.S. Citrus and Subtropical Products Laboratory,*  
*Winter Haven, FL*  
Robert A. Baker, (813) 293-4133

**Jointed goatgrass seeds that contaminate** winter wheat seed can be removed from harvested grain by using an ARS invention. The weed infests 15 Western states, causing annual losses of about \$150 million to wheat growers. ARS designed a new liner to attach inside indent-cylinder machines for seed cleaning. The liner could also be manufactured as a permanent part of new cylinders that would fit onto existing machines. As seeds tumble in the spinning cylinder, they lodge briefly in the liner's parallel, grooved pockets. Plump wheat seeds slip from the pockets sooner than the long seeds of goatgrass, which are flung into a catch pan. Too, the invention can remove wild oats' long, thin seeds, or shriveled wheat seeds. (PATENT 5,163,565)

*National Forage Seed and Cereal Research Center,*  
*Corvallis, OR*  
Richard A. Caskey, (503) 750-8722

## Biological Control

**Flowerhead weevils have begun gnawing** their way through Texas' much-hated musk thistle, five years after scientists released these petite Mediterranean insects at Kerrville as a non-chemical control against the weed. Musk thistle occupies large sections of pasture with its spiny leaves and flowerheads that discourage grazing anywhere nearby. It's considered a problem in 26 states, and has taken over a large portion of central Texas in the past decade. The flowerhead weevil, found by ARS scientists during an overseas "bug hunt," lays about 200 eggs in the thistle's flowerhead. The emerging larvae feed on the plant's seed receptacle, resulting in production of seeds that don't form normally and can't germinate. In research plots at Kerrville in 1992, 50 to 90 percent of all musk thistle flowerheads were damaged by the weevils. Researchers say the weevil apparently spent its first five years in Texas adapting to its new environment. The weevil poses no threat to any plant other than musk thistle.

*Grassland Protection Research, Temple, TX*  
Paul E. Boldt, (817) 770-6530

**The fight against corn earworms**, cotton bollworms and related insect pests gained some ground when scientists recently found that once a parasitic wasp attacks a caterpillar, it won't waste time laying another egg in the same prey. That finding is part of an ongoing study of the behavior of the wasp, *Microplitis croceipes*, which is harmless to humans but attacks the larvae of the Helicoverpa moth family. These moths cause an estimated \$1.2 billion in damage to crops each year. Scientists confirmed that as the wasp lays an egg, it releases a chemical onto the caterpillar. This chemical is a marker that tells the wasp to pass over those caterpillars in search of new prey in which to lay its eggs. It's the wasp's way of efficiently reproducing, because only one wasp offspring can hatch in each caterpillar. Scientists have also found that a plant under attack helps draw the wasps to the caterpillar. When the caterpillar begins feeding, the plant gives off chemicals that act as a beacon that the wasps use to zero in on the caterpillars.

*Insect Biology and Population Management Research*  
*Lab, Tifton, GA*  
W. Joe Lewis, (912) 387-2369  
*Chemistry Research, Gainesville, FL*  
James H. Tumlinson III, (904) 374-5730

**A natural biocontrol virus** can be mixed in irrigation water to kill insects that cause major damage to corn and cotton. When the nuclear polyhedrosis virus was sprayed on corn from overhead sprinklers, it reduced corn earworm larvae by 25 to 100 percent, depending on the timing and rate of virus application, according to field studies. The new approach is more cost-effective for growers because



they can combine irrigation and pest control. The virus affects only the targeted *Helicoverpa/Heliothis* insects, among the most serious agricultural crop pests. The virus is harmless to other insects, humans and other mammals. Once the virus is sprayed, the insect pest larvae eat it and die within three to five days, depending on the dosage. It was most effective when applied first when corn tassels form and then three times when the silks begin to form.

*Insect Biology and Population Management Research  
Lab, Tifton, GA*

*John J. Hamm/Laurence D. Chandler,  
(912) 387-2323/2326*

**An artificial diet has been developed** to mass-rear Colorado potato beetles that scientists need in searching for non-chemical controls of the insect. Similar to cheese in appearance and texture, the diet tastes enough like a potato plant to fool the beetle. A major pest of potatoes in North America and Europe, the Colorado potato beetle is becoming increasingly resistant to most types of insecticides. Beetles for research currently are reared on potato plants in greenhouses. That's a costly and time-consuming job. An ARS scientist developed the new diet of protein, sugar, vegetable oil, amino acids, vitamins, minerals and cholesterol—all commercially available and relatively inexpensive. It also can be laced with fungi or other natural substances to test whether they are harmful to the potato beetle. If successful, these substances could be genetically engineered into potato plants.

*Vegetable Laboratory, Beltsville, MD  
John Domek, (301) 504-8395*

**A naturally occurring fungus, *Colletotrichum truncatum*,** can control *hemp sesbania*, one of the most common weeds infesting southern soybean, cotton and rice fields. In field tests, the fungus killed more than 90 percent of the weed when applied in a mixture of oil droplets suspended in water. That's comparable to the level of control from a commercially available chemical herbicide. Small-scale field tests have demonstrated that, if applied dry, the fungus is most effective when six to 10 hours of dew occur after application. ARS scientists are developing methods to mass-produce the fungus so it can be tested on a larger scale. Federal regulatory approval would be necessary before the fungus could be used commercially. (PATENT APPLICATION 08/068,872)

*Weed Biology and Management Research,  
Stoneville, MS  
C. Douglas Boyette, (601) 686-5313*

**Pear psylla, the most destructive pest of pears in the** United States, may have met its match when challenged by three naturally occurring fungi discovered by ARS scientists. In lab tests, the fungi invaded and killed 100 percent of pear psylla in five days. Field tests are underway. After

killing their host, the fungi release hundreds of spores, each able to infect another pear psylla. The fungi—strains of *Beauveria*, *Verticillium* and *Paecilomyces*—are not known to be harmful to humans, animals or beneficial insects. Because they can become established in the ecosystem and last indefinitely, the fungi may be more effective over time than chemical controls. The fungi were collected from aphids and other psylla species, since no fungal pathogens had ever been identified on pear psylla.

*Appalachian Fruit Research Laboratory,  
Kearneysville, WV  
Gary J. Puterka, (304) 725-3451*

**Southwestern ranchers are getting a natural helping hand** against honey mesquite from a native insect called mesquite cutworm. During its 14-day development period, each mesquite cutworm larvae can destroy up to 10 leaves on the unwanted shrub. The larvae initially concentrate on young leaves, but later feed and develop normally on a diet of full-grown leaves alone. Although very young larvae consume about a fourth of their daily intake during daylight hours, older larvae feed almost entirely at night, hiding under litter on the ground during the day. Researchers say these eating habits enable the cutworms to escape nocturnal predators that are primarily on the ground and daytime predators that are mostly in the trees, making the cutworm a more effective control agent of mesquite. The cutworms periodically defoliate mesquite over a wide area of central Texas, researchers say.

*Grassland, Soil and Water Research, Temple, TX  
C. Jackson DeLoach, (817) 770-6531*

## Human Nutrition

**Two suspected risk factors in breast cancer—moderate alcohol consumption and exposure to estrogen hormones—** have now been linked. A six-month study at ARS' Beltsville Human Nutrition Research Center was one of the first long-term, controlled-diet experiments of its kind. The equivalent of two mixed drinks a day increased estrogen levels seven to 32 percent during the menstrual cycle of 34 healthy women volunteers 21 to 40 years old. The results suggest moderate alcohol consumption may be one mechanism responsible for elevated estrogen—long implicated in breast cancer. Results may also explain why some earlier studies implicated moderate drinking as a risk factor. ARS jointly conducted the study with the National Cancer Institute. The scientists measured estrogen hormones in blood and urine samples about a week before, during, and a week after ovulation. The greatest increase in hormones was in the week of ovulation.

*Lipid Nutrition Lab, Beltsville, MD  
Joseph Judd, (301) 504-9014*



**Regular aerobic exercise can lower people's risk of diabetes**, even if they don't lose weight in the process. That's the finding of a three-month study of 18 older men and women who had above-normal glucose levels on a glucose tolerance test. This puts them at a nine- to 10-fold greater risk of diabetes. But the 18 volunteers cleared 11 percent more glucose from their blood after cycling on an ergometer four days per week. After 12 weeks, the exercise improved the ability of their cells to respond to insulin, allowing them to process the glucose more efficiently. The finding supports other research showing that exercise itself improves people's insulin sensitivity. That's good news because weight loss—widely prescribed as a treatment for diabetes—is often not permanent.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*  
*Virginia A. Hughes, (617) 556-3079*

**Some folk remedies for diabetes** appear to be based on fact rather than fiction. That's what ARS researchers are finding in studies to identify foods that may help control diabetes in lieu of drugs. They used a well known test-tube assay of insulin activity to screen extracts of 24 plants that have a reputation for antidiabetic properties. The assay measures the ability of a substance to enhance glucose oxidation in the presence of insulin. Nine of the 24 plants boosted insulin activity from two- to 4.5-fold. The common weed, loosestrife (*Lythrum salicaria*), produced the biggest increase. Others were bearberry (*Arctostaphylos uva-ursi*); hops (*Humulus lupulus*); lavender (*Lavandula stoechas*); oregano (*Origanum vulgare*); sage (*Salvia officinalis*); dandelion (*Taraxacum officinale*); sweet bay (*Laurus nobilis*); and birch (*Betula lenta*). These substances are generally prepared as teas or tinctures. Sage and oregano are common herbs used in cooking. Hops and lavender are food additives generally recognized as safe. Earlier assays found several spices, such as cinnamon and turmeric, to be effective. The researchers ultimately hope to test the most effective compounds in human studies.

*Beltsville Human Nutrition Research Center, Beltsville, MD*  
*Richard A. Anderson, (301) 504-8091*  
*National Germplasm Resources Lab, Beltsville, MD*  
*James A. Duke, (301) 504-5419*

**Cholesterol's bad reputation** apparently doesn't hold up for infants. A study of four-month-old infants indicates that they need more cholesterol than commercial formulas provide. The group getting formula containing one-sixth the cholesterol in breast milk made their own cholesterol three times faster than the breast-fed infants. Even with the faster synthesis, the formula-fed group had 39 percent less cholesterol circulating in their blood than the breast-fed infants. And LDL-cholesterol—which has the bad reputation—was nearly twice as high in the breast-fed babies.

The findings again raise the question whether cholesterol should be added to infant formula. Cow-milk-based formulas contain less than 25 percent of the cholesterol in mother's milk, and soy-based formulas contain less than seven percent. Some animal studies have led scientists to speculate that the high-cholesterol intake infants get from mother's milk may help protect them later in life from diet-induced increases in plasma cholesterol. But studies with other animals did not show this long-term benefit. Further research comparing former breast-fed and formula-fed infants is needed before any solid recommendations can be made. This study was the first of its kind done on human infants.

*Children's Nutrition Research Center, Houston, TX*  
*William W. Wong, (713) 798-7168*

**People can't substantially raise vitamin E levels in their blood by diet alone.** It takes a daily vitamin E supplement of at least 100 International Units (I.U.), according to a new study. In light of recent evidence suggesting that taking vitamin E supplements protects both men and women against coronary artery disease and reduces risk of certain cancers, researchers with the National Cancer Institute and ARS looked at the relationship between vitamin E intake and plasma levels in 65 men. Vitamin E intake from the diet did not differ significantly among the men. Their diets provided less than 15 I.U. per day. But they fell into three groups based on their use of vitamin supplements: those who did not take supplements on any regular basis; those who got an extra 15 to 60 I.U. daily from multivitamin supplements; and those who got an extra 100 I.U. or more from a vitamin E capsule. Compared to the group that did not take any supplements, plasma vitamin E levels were somewhat higher (14 percent) in the group that took multivitamin supplements. But they were more than twice as high in the group that took vitamin E capsules on a daily basis. It is virtually impossible to get 100 I.U. of vitamin E from diet alone. The normal adult intake is 10 to 15 I.U. And because it is a fat-soluble vitamin, the richest sources are vegetable oils and the high-fat products made from them. Unfortunately, science has not yet determined what levels of plasma vitamin E are necessary to protect against heart disease or cancer.

*Beltsville Human Nutrition Research Center, Beltsville, MD*  
*Orville Levander, (301) 504-8504*  
*National Cancer Institute, Bethesda, MD*  
*Rashmi Sinha, (301) 496-1691*

**Test animals cope with a copper-deficient diet** far better when given only 60 to 70 percent of the calories they would normally eat. Results of two recent rat studies suggest a possible relationship between the effects of copper deficiency and aging because copper-deficient diets are known to produce several symptoms common to aging—including



anemia and damage to the heart muscle. And in numerous animal studies by other investigators over several decades, restricting food intake throughout life has dramatically delayed the onset of age-related diseases and nearly doubled the animals' life span. Such studies have not been done on people, however. In the latest studies, rats fed the restricted diet had significantly less anemia and heart enlargement from the copper-deficient diets than those who got all the food they could eat. They also lived substantially longer: all survived until day 42 compared with 40 percent of the well-fed group. What's more, a copper-containing enzyme—SOD—was more active in the food-restricted group, indicating they had better protection against oxygen free radicals.

Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Jack T. Saari, (701) 795-8499

### Soil, Water and Air

Spreading a thin dusting of gypsum on reclaimed mining lands reduced high sodium levels in the soil. The sodium threatened to scuttle efforts to reclaim the former bentonite mines for grazing by livestock and wildlife. Earlier, researchers unlocked the secret to restoring plant life on such areas: add fertilizer and lumber-mill wastes. But long-term survival of grass and shrubs depends on controlling sodium levels. Scientists showed that the gypsum reduced by 22 percent the sodium in the top 24 inches of soil after just three years.

High Plains Grasslands Research Station, Cheyenne, WY  
Gerald E. Schuman, (307) 772-2433

Friendly soil fungi can help plants survive and grow on lands left barren after mining. The vasicular-arbuscular mycorrhizal (VAM) fungi invade plants' roots, then form long strands in the soil through which nutrients are passed back to the plant. In return, the plant supplies the fungi with vital carbon. Iron ore mining companies now apply large amounts of phosphorus fertilizer to get permanent vegetation growing on mine tailings. But often within a few years, the tailings and phosphorus bind together too tightly for plants to benefit from the phosphorus. In tests, a VAM fungus called *Glomus claroideum* helped big bluestem and little bluestem grasses grow well on mine tailings even when available phosphorus levels were less than half the levels needed by most farm crops.

Plant Science Research, St. Paul, MN  
Michael P. Russelle, (612) 625-8145

Fertilizer rates, grass species, and area grazing practices had modest effect on the quality of surface water runoff on 14 watersheds of the Southern Plains of Oklahoma and Texas. These and other key results from studies up to 13

years long are providing valuable information to scientists on the concentrations and amounts of sediment, nitrogen and phosphorus in the vast grasslands of Reddish Prairie and Rolling Red Plains land resource areas. Nutrient and sediment losses were greatest from watersheds with established, active gullies. Annual soluble nutrient losses in surface runoff tended to be small. Soluble nitrogen in surface water runoff posed few water quality problems. But soluble and total phosphorus often exceeded proposed critical limits for nutrient overload of surface waters—even on the more pristine watersheds. High nitrate-nitrogen levels were sometimes found in groundwater beneath certain watersheds with water tables less than 20 meters deep and with medium-texture soil that had been nitrogen fertilized and seeded with introduced or native grasses.

Water Quality Research, Durant, OK  
Frank Schiebe, (405) 924-5066

A newly discovered species of nematode appears to be one of the causes of the 20-year-old mystery of the dying dunegrass. *Ammophila breviligulata*, American beachgrass, is the primary plant used to build and stabilize sand dunes along the mid-Atlantic coast. These dunes help reduce shoreline damage and flooding from storms. But sporadically since about 1973, lush beachgrass has withered to dead-looking brown stubble on many dunes from Massachusetts to North Carolina. Two years ago, ARS and University of Delaware scientists found several species of nematodes on and around the grass roots. These root-feeding organisms choke off the leaves' nutrient and water supply, explaining one of the factors involved in the 20-year mystery. And ARS scientists now have identified one of the organisms as a newly identified species of root-knot nematode. It's in the genus *Meloidogyne*, which includes many crop pests. In greenhouse tests, this new species of nematode reproduced on roots of coastal beachgrass, St. Augustine grass, Zoysia grass, bermudagrass, wheat, rice and oats. That doesn't mean it currently is a crop and lawn pest, but crop specialists now can keep an eye out for it. Sand-dune experts also are using the research findings to work out new ideas for controlling the beachgrass nematodes.

Nematology Lab, Beltsville, MD  
Zafar Handoo/Robin Huettel/A. Morgan Golden,  
(301) 504-6666

Underground tubing typically used to drain saturated soils can also double as an irrigation system in drier times. When soils are water-soaked, the excess water percolates into the perforated tubing and is carried to a discharge outlet. A simple control valve added on the discharge outlet lets farmers hold the water in the tubing when it's needed for irrigation. If necessary, additional water can be poured into the system through a standpipe, a vertical pipe that runs from the soil surface into the drainage system.



The tubing's perforations provide a constant supply of moisture where it's needed most—at the root zone. Soybeans grown in Ohio and irrigated in this manner yielded an average 80 bushels per acre; corn yields may be boosted 50 to 60 bushels per acre. The underground tubing system and control valve are commercially available.

*Soil Drainage Research, Columbus, OH*

*Norman R. Fausey, (614) 292-9806*

*Corn and Soybean Research, Wooster, OH*

*Richard L. Cooper, (216) 263-3875*

**Overnight reports from a computerized weather network** are helping Colorado farmers save water and get an early jump on insect and disease problems. Each night, 22 weather stations feed the previous day's data via telephone lines to ARS and Colorado State University computer programs. The programs use the data to forecast irrigation needs and potential disease and insect infestations. Last year, onion growers who followed the network's warnings escaped serious fungal damage to their crop, while other growers sprayed fungicides too late. Some irrigators could reduce water use by up to 30 percent by following the network's recommendations.

*Water Management Research, Ft. Collins, CO*

*Harold R. Duke, (303) 491-8230*

**Cotton plants may draw 25 to 50 percent** of their water needs from an underground source—shallow groundwater that accumulates several feet beneath the surface when a deeper soil or rock layer blocks further percolation. Data from an ARS study, now in its third year in California's San Joaquin Valley, may help growers easily calculate the feasibility of using shallow groundwater if it accumulates beneath their fields. This strategy reduces some of the need for irrigation water. Too, it reduces the amount of sometimes-salty shallow groundwater that's carried to rivers or evaporation ponds in underground networks of plastic drainpipes. And it increases the shallow groundwater's distance from the soil surface—decreasing the risk that salty groundwater will evaporate and raise soil salinity. In the arid west, shallow groundwater is usually the result of overirrigation.

*Water Management Research Laboratory, Fresno, CA*

*James A. Ayars, (209) 453-3104*

**A sensor invented to check organic matter** and moisture levels in soil has been redesigned to better help farmers and agricultural consultants decide how much herbicide to apply. The tractor-mounted device bases its measurements of organic matter and moisture on the amount of light reflected by the soil, providing information in seconds. The redesigned sensor is entirely self-contained; the original sensor, developed by engineers from ARS and Agmed, Inc. of Springfield, IL, required a separate computer. Readings were slower, too, taking about a minute. ARS shares the

patent for the original sensor with Agmed, the company licensed to make and sell the sensor. The modifications to the original sensor have not been patented.

*Cropping Systems and Water Quality Research,  
Columbia, MO*

*Kenneth A. Sudduth, (314) 882-4090*

## Scientific Information Systems

**Insect infestations in stored grain** can be reduced with a computer program developed by ARS researchers that predicts effects of various storage conditions. Operators provide information on the grain's initial temperature and moisture, how long it will be stored and whether it will be aerated. The system then tells them how long it can be safely stored. The program may point out potential problems and suggest changes to avoid or limit insect infestations. The program also can help identify pests. Field tests are under way to check the accuracy of the system's recommendations and predictions of insect growth. It's being adapted for use by commercial grain storage facilities, and is expected to be available for widespread use later this year.

*Biological Research, Manhattan, KS*

*Paul W. Flinn, (913) 776-2707*

**Computer maps are helping cotton growers** plot strategies to suppress the boll weevil in Mississippi. Color-coded maps produced by ARS scientists show the varying densities of weevil populations in cotton-growing counties. Every two weeks, more than 1000 growers count weevils caught in field traps. They relay this data to scientists, who produce and update the maps using software known as a geographic information system. Tracking weevil population trends by computer helps growers pinpoint if, where, when, and how much pesticide should be applied to fields. Also, the maps let researchers, extension service agents and growers evaluate controls that use little or no chemical insecticide, especially for environmentally sensitive areas such as wildlife habitats. By the late summer of 1993, the maps should cover all of the state's 62 cotton-growing counties. Eradication programs in North Carolina, Georgia, Alabama, Florida and other states, have helped growers eliminate boll weevils as a threat to their cotton crops.

*Boll Weevil Research, Mississippi State, MS*

*James W. Smith, (601) 323-2230*

**Potato growers coast-to-coast** can now rely on SIMPO-TATO for advice on how much water or fertilizer to use, and when to apply it. The new experimental computer program helps farmers conserve water and energy, and avoid groundwater pollution that results when nitrates leach from excess fertilizer. Unlike computer models that project potato plants' water needs by relying on a standard graph of



plant growth, SIMPOTATO calculates the current crop's daily growth using weather updates furnished routinely by the farmer. The program runs on IBM or IBM-compatible computers and requires about 400k of memory and 500k of disc space. It's available on floppy discs or via INTERNET (mailcode: thodges@beta.tricity.wsu.edu).

*Irrigated Agriculture Research, Prosser, WA  
Tom Hodges, (509) 786-3454*

## Animal Production and Protection

**Senepol cattle, a cross of English and African breeds,** appear to cope with hot weather even better than Brahman, the beef industry's longtime choice for steamy climates. Ongoing studies begun in 1988 have compared Senepol, Angus, Brahman and Hereford cows, heifers and calves during Florida's hottest and most humid months. Researchers repeatedly checked rectal temperatures, considered a valid indicator of heat tolerance. Senepols consistently had the lowest temperatures, regardless of age. In another study, Senepol and Hereford cows' grazing time was measured over several hot summer weeks in 1990 and 1991. Results showed Senepols continued grazing—and theoretically putting on weight—for 10.5 to 10.7 hours a day, compared with only 9.3 hours for the Herefords. The researchers noted a connection between rectal temperatures and grazing time; the higher the temperatures, the less those animals grazed.

*Subtropical Agriculture Research Station,  
Brooksville, FL  
Andrew C. Hammond, (904) 796-3385*

**Studies of a cat virus have led** to the development of a diagnostic test for vesicular exanthema of swine virus (VESV). ARS researchers were directed by Congress to study the cat virus, feline calicivirus, because it's a model for the swine virus. Although VESV was eradicated from the United States more than 30 years ago, another virus indistinguishable from VESV has been isolated from marine mammals and fish along the West Coast. If VESV is reintroduced in U.S. pigs, the new diagnostic test could reduce economic losses in the swine industry.

*Virology Swine Research, Ames, IA  
Roger D. Woods, (515) 239-8358*

**Pharaoh ants are usually considered indoor pests,** but putting toxic baits outdoors is an effective way to control them. These pests infest hospitals, food establishments, offices, apartments and other buildings. Although they live inside, they often forage outside for food that they can bring back to their nests. To control the pests, scientists placed commercial bait stations containing a delayed-action insecticide along the exterior walls of apartment buildings. The researchers found that within one week, Pharaoh ant

populations were reduced by 90 percent. Outdoor control with bait stations may result in lower control costs and will mean less exposure to insecticides indoors.

*Medical and Veterinary Entomology Research  
Laboratory, Gainesville, FL  
David H. Oi/David F. Williams, (904) 374-5946*

**Young horn flies that grow up to bite and irritate cattle** may not grow up at all if their parents are treated with the chemical pyriproxyfen, an insect growth regulator. In laboratory tests, offspring simply failed to develop to adults and ultimately died after parent horn flies were exposed to pyriproxyfen. Still in the experimental stage, pyriproxyfen also proved an effective control when mixed in the diet to rear larvae. In other tests, adult flies quickly absorbed pyriproxyfen, but their bodies were very slow to break down and excrete it—desirable attributes in an insect control agent. Further evaluations are needed on pyriproxyfen's effectiveness in the field against horn flies—a significant cause of reduced weight gains in beef cattle and milk production in dairy cattle. New weapons are needed because the pest has been able to develop resistance to many conventional chemicals.

*Food Animal Protection Research, College Station, TX  
Don L. Bull, (409) 260-9401*

**Florico is a newly released stargrass forage** that is well adapted to many tropical soils. Developed jointly by researchers with ARS, the Florida Agricultural Experiment Station and the Puerto Rico Agricultural Experiment Station, Florico yields between six and 7.5 tons per acre when grown with adequate moisture and fertilizer. In tests, intensively managed Florico averaged 60 percent digestible organic matter and 12.5 percent crude protein. Steers gained an average of one pound per day when grazing on Florico in a rotational grazing system. Florico is suited mainly for the southern two-thirds of Florida and warmer tropical areas of the world, and is considered to offer better grazing than other tropical forages. Florico is vegetatively propagated; information about planting material is available from the Florida Foundation Seed Producers Inc., P.O. Box 309, Greenwood, FL 32433.

*Subtropical Agricultural Research Station,  
Brooksville, FL  
Mimi J. Williams, (904) 796-3385*



# Quarterly Report

of Selected Research Projects July 1 to September 30, 1993

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

### Cooperative Research and Development Agreements

...With Pioneer Hi-Bred International Inc., of Johnston, IA, to study the development of transgenic corn varieties that produce grain resistant to insect damage while in storage. ARS scientists are testing the ability of natural proteins to inhibit the growth of beetles and moths that commonly infest stored corn. Pioneer is working on transferring into corn the genes that promote production of proteins harmful to the pests. These joint studies may help give the United States an edge in the competitive grain export market, offering international buyers higher-quality corn that can be stored for long periods without pest infestations.

ARS Contact: Karl J. Kramer, Biological Research, Manhattan, KS, (913) 776-2711

...With EcoScience Corp. of Worcester, MA, for investigating beneficial yeasts that protect harvested apples, pears, and other fruits from molds and rots. ARS researchers

identified and received a patent for a naturally occurring yeast, *Cryptococcus laurentii*, that fends off blue mold, gray mold, and Mucor rot. If unchecked, the molds and rot leave fruit soft, smelly and watery. EcoScience researchers are exploring opportunities for mass-producing and marketing this yeast or other helpful microbes for use on fresh produce. That could cut losses from decay and reduce or eliminate the need for spraying fruit with chemical fungicides.

ARS Contact: Rodney G. Roberts, Tree Fruit Research Laboratory, Wenatchee, WA, (509) 664-2280

...With Biospherics Inc. of Beltsville, MD, to test carbohydrates for controlling house flies in poultry houses. These flies—pests to both hens and farm personnel—also can migrate to nearby housing developments, where they have been the subject of many lawsuits. Preliminary tests have shown that some carbohydrates are toxic to the early larval stages of house flies that develop in chicken manure. The carbohydrates, developed by the company, are non-toxic to chickens and humans and are safe for the environment. ARS researchers will test the effectiveness of the compounds against fly larvae and the best application methods.

ARS Contact: Richard W. Miller, Livestock Insects Laboratory, Beltsville, MD, (301) 504-8478

...With Applied Instrumentation of Concord, CA, to compile information on peanut moisture levels to calibrate a portable monitor developed by the company. Sensors linked to the monitor feed information about the peanuts' moisture to a hand-held meter. Moisture sensors mounted inside peanut trailers offer a truer picture of peanut-moisture content of the entire trailer and allow sampling of about 200 pounds of peanuts per trailer, compared with the current 200 grams in as much as four to five tons of peanuts. If peanuts are too dried, they split, reducing the quality and sometimes causing an off-flavor. But if peanuts are not dried to the recommended level, subsequent fungal growth could lead to aflatoxin contamination. The cost to install moisture sensors on peanut trailers is relatively low because common materials are used and are available from local retailers.

ARS Contact: Christopher L. Butts, National Peanut Research Laboratory, Dawson, GA, (912) 995-4441

...With Atlantic Orient Corporation of Norwich, VT, to improve performance of medium-sized windmills. Windpower is quickly becoming an attractive method of generating electricity for rural areas. Electrical output is sometimes reduced by a buildup of bugs, grease, dust and

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.



other debris on the leading edges of windmill rotor blades. Currently, windmill operators often wash the blades once or twice a month. ARS engineers are helping to design, build and test a more reliable and maintenance-free windmill with a new type of blade. These blades have a profile that regulates electrical power output when they are clean and minimizes power loss when dirty. Wind tunnel tests of dirty blades show that performance may be improved by 40 to 50 percent. Combining these new blades with a new compact drivetrain should make a windmill that produces electricity at about two-thirds of today's cost, making it more competitive with current utility prices.

*ARS Contact: R. Nolan Clark, Conservation and Production Research Laboratory, Bushland, TX, (806) 356-5734*

**...With Veterinary Diagnostic Technology, Inc. of Wheat Ridge, CO,** to produce a new test for detecting bluetongue viruses in sheep and cattle. Current tests are expensive and hard to use and sometimes fail to detect infected animals. Bluetongue disease causes millions of dollars annually in lost exports to countries that are bluetongue-free. The new test will use state-of-the-art enzyme-linked immunosorbent assay (ELISA) technology that researchers adapted to analyze blood from animals. Cooperators also will work on tests for detecting antibodies to epizootic hemorrhagic viruses that cause a disease—similar to bluetongue—in cattle and deer.

*ARS Contact: James O. Mechem, Arthropod-Borne Animal Diseases Research Laboratory, Laramie, WY, (307) 766-3620*

**...With BIOSYS of Palo Alto, CA,** to study the potential of parasitic nematodes to quell the soilborne sugarbeet root maggot fly. The maggots are a major insect pest of sugarbeets grown in the western half of the United States. They burrow in the soil and feed on sugarbeet roots, reducing plant populations and crop yields. Several strains of nematodes from the *Steinernematidae* and *Heterorhabditidae* families will be evaluated for their ability to infect and kill the pest.

*ARS Contact: Garry A. Smith, Sugarbeet Research, Fargo, ND, (701) 239-1350*

**...With Idexx Corp. of Portland, ME,** for cloning proteins that stimulate chickens' immune systems against coccidia parasites. Prevention and control of coccidiosis cost \$450 million annually. The birds' white blood cells recognize foreign invaders and naturally produce the proteins—known as lymphokines. The proteins, in turn, stimulate the production of more white blood cells programmed to attack and kill the interlopers. ARS scientists will clone the chicken genes for the specific proteins against coccidia and insert them into harmless bacteria to produce large quantities of the proteins. Then they will inject the proteins into

chickens together with anti-coccidial vaccines. The proteins should boost natural immunity in chickens and enhance the effectiveness of vaccines by stimulating production of white blood cells that kill the parasites—a task that traditional vaccines are not good at. Idexx Corporation will use the cloned genes to develop and manufacture diagnostic tests for chicken lymphokines.

*ARS Contact: Hyun S. Lillehoj, Protozoan Diseases Laboratory, Beltsville, MD, (301) 504-8771*

**...With Nippon Zeon Co. LTD., Tokyo, Japan,** to develop a genetically engineered vaccine against poultry coccidiosis. This parasite costs U.S. poultry farmers \$450 million annually in medication and lost meat production. World-wide the annual loss is \$1.5 billion. ARS scientists will supply the company with selected genes from coccidia parasites which code for parts of the parasite that chickens develop immunity to. Nippon Zeon scientists will insert these genes into the genome of weakened strains of fowlpox virus. The viruses are normally used in vaccines developed against chicken fowlpox, an occasional problem in U.S. flocks. Fowlpox viruses that contain the "transplanted" coccidial genes and produce coccidial proteins will be tested by ARS scientists to see if they can immunize chickens against coccidiosis. Even though effective drugs against chicken coccidiosis are available, a vaccine against the parasite is necessary because of developing resistance to current drugs and the expense of developing new ones.

*ARS Contact: Mark C. Jenkins, Protozoan Diseases Laboratory, Beltsville, MD, (301) 504-8054*

## Patent Licenses

**...To Perten Instruments North America, Inc. of Reno, NV,** to commercialize an ARS-patented device that rapidly tests hardness of wheat samples, kernel by kernel. USDA's Federal Grain Inspection Service expects the commercial version to be in use in 1995 for officially classifying wheat as hard or soft. That's important in marketing wheat because different types of wheat have various product uses. Traditionally, wheat classification has been based on visual inspection of kernels. But breeders have crossbred wheat to maximize desirable traits, making it increasingly difficult to separate hard and soft wheat. Now the ARS-developed instrument can do just that by weighing one kernel at a time, then crushing it to gather measurements of moisture, hardness and size.

*ARS Contact: Charles R. Martin, Engineering Research, Manhattan, KS, (913) 776-2730*

**...To Dynic Corporation of Tokyo, Japan,** for products made with a textile-coating process that makes fabrics respond to changes in temperature. ARS scientists invented the technology, which binds a class of chemicals called PEGs (short for polyethylene glycols) to fibers. This newer



process binds the PEGs using a non-formaldehyde agent. PEGs make the fabric absorb and store heat when the temperature rises and release it when the temperature drops. Treated fabrics also have many other improved properties such as high water absorbency, excellent soil release, durable press wear, resistance to static charge and pilling (balls of lint), and suppression of bacteria, fungi and body odors. Dynic will use the technology to manufacture products such as interlining for fabrics for sale only in Japan. (PATENT APPLICATION 07/863,274)

ARS contact: Tyrone Vigo, Southern Regional Research Center, New Orleans, LA, (504) 286-4487

...To British Technology Group USA, Inc., to use an ARS-patented technique to produce transgenic plants by moving genetic material from one plant into the pollen of another. In the process, called electroporation, genetic material called DNA is transferred into pollen via a split-second shock of electricity. That shock opens pollen cell pores through which the DNA can move. Pollen with the transferred DNA is then placed back on the flower to produce seed. This seed—and the plants that grow from it—can be screened to see if they have the genetic traits contained in the altered pollen. The technique has been used in tobacco as a model system. It is also being applied to alfalfa and corn, but scientists say it can be used for any flowering crop. (PATENT APPLICATION 07/530,485)

ARS Contact: James A. Saunders, Plant Sciences Institute, Beltsville, MD, (301) 504-7477

## Biological Control

A troublesome, prickly weed—the Canada thistle—gives off chemical aromas that will arouse a usually “sleepy” fungus to destroy the thistles. Seeds and roots of this weed emit the volatile chemicals that betray it. ARS researchers found that the aromas stimulate a fungus, *Puccinia punctiformis*, to produce spores that infect the thistle and kill it. Under normal conditions, the spores are often dormant and germinate very slowly. But, in lab tests, the volatiles increased *P. punctiformis* spore germination up to 75 percent—making the fungus more effective and strengthening its potential as a non-chemical way to control the weed. Canada thistle, found across the northern half of the United States, is considered one of the most serious weeds infesting cropland. A biocontrol is needed because the weed is resistant to most herbicides, plus chemical controls that are effective are costly.

Foreign Disease-Weed Science Lab, Frederick, MD  
Richard C. French, (301) 619-7312

A tiny Spanish wasp that kills sweetpotato whiteflies might stay alive to hunt whiteflies even when fields are sprayed with insecticide. Such integration of biological

with chemical controls would be valuable to farmers combatting whiteflies. But it's been elusive up to now, since most insecticides also kill a pest's natural enemies. Now, ARS scientists may have found an exception. Scientists soaked leaves in each of seven insecticides and put the leaves in cages with four species of parasitic wasps. The best survivor was Spain's *Eretmocerus mundus*: A surprising 40 percent withstood cypermethrin and thiodicarb. Next, scientists will try breeding more resistance into this wasp. If they succeed, the wasp could be released to attack whiteflies in fields sprayed for other pests like boll weevils and cabbage loopers. None of the four test wasp species was killed by buprofezin, an insect growth regulator not currently registered for use. The other three test wasps were *Encarsia formosa* from Egypt and two common local parasites—*Eretmocerus californicus* and *Encarsia pergandiella*. The foreign wasps were collected by ARS researchers based in France.

Biological Control of Pests Research, Weslaco, TX  
Walker A. Jones, (210) 969-4803  
European Biological Control Laboratory,  
Montpellier, France  
Alan A. Kirk, 33-67-04-56-00

Australian tobacco plants yield new biopesticides against sweetpotato whiteflies and other crop-damaging insects. After evaluating 17 species of tobacco, ARS scientists found that extracts from three species that were not of smoking quality were highly effective in killing immature sweetpotato whiteflies, green peach aphids and spidermites that have attacked crops in western states the last couple of years. Greenhouse tests showed the most potent was a mixture of four similar compounds of *Nicotiana gossei*—which killed 88 to 94 percent of immature whiteflies. A one percent mixture of the compounds also controlled the greenhouse whitefly and the green peach aphid, and prevented the two-spotted spidermite from feeding and reproducing. A one-tenth of one percent mixture in water was as good as, or better than, recommended mixtures of commonly available biocontrol products and pesticides. The purified product was stable for one year. A patent has been granted and scientists are looking forward to product development. (PATENT 5,260,281)

Florist and Nursery Crops Laboratory, Beltsville, MD  
John Neal, (301) 504-9159

Corn borers can't develop normally if they are fed an anti-hormone-like chemical called KK-42. In laboratory tests, the chemical appeared to interfere with the insect's production of two hormones essential for maturing. Scientists want to develop more powerful versions of KK-42 for commercial use to control corn borers—which cost farmers as much as \$250 million annually in Iowa alone. Other tests have shown KK-42 will stop development of the gypsy

moth caterpillar, which defoliated four million acres of hardwoods in 1991.

*Insect Neurobiology and Hormone Laboratory,  
Beltsville, MD*

*Dale B. Gelman/Robert A. Bell, (301) 504-8909/8015*

**Friendly soil microorganisms may help stop costly invasions of jointed goatgrass, an aggressive weed in wheat fields.** Goatgrass infests more than five million acres of winter wheat in the United States, reducing wheat yields and causing other losses totalling more than \$145 million annually. Now, ARS scientists have reported successful tests of three different strains of beneficial microorganisms, each a form of *Pseudomonas* bacteria. The microbes colonized goatgrass roots and reduced the weed's growth in lab, greenhouse and field tests—without harming wheat plants. At one outdoor site, the number of goatgrass plants was 20 to 40 percent less in soil sprayed with a water-microbes mix. Ongoing tests are revealing other promising soil bacteria and the best strategies for applying them. (PATENT 5,163,991)

*Land Management and Water Conservation Research,  
Pullman, WA*

*Ann C. Kennedy, (509) 335-1554*

**Targeting pests that attack black walnut trees in the United States has been made easier.** For two years, the seasonal flight patterns of 92 species of an insect family called plant bugs (*Heteroptera: Miridae*) were studied by collecting these pests in sticky traps set at various heights on black walnut trees in southern Illinois and North Carolina. Flying heights and seasonal flight activities of the six most common plant bugs were studied in detail and compared to find out how abundant these pests are and to track their seasonal movements. Only three of the 92 species were identified as true pests of walnuts; one was identified as a species new to science that was discovered for the first time. This information will be invaluable to scientists developing biocontrol strategies to better control pests of black walnut trees.

*Systematic Entomology Laboratory, Washington, DC  
Thomas Henry, (202) 382-1780*

**Biocontrol insects are catching a ride from the laboratory to the field in specially designed, pillow-case-sized bags.** Thousands of insects can rest on walls without being on top of each other. The bags take up less space than costlier and bulkier cages. In Florida pilot studies to control the Caribbean fruit fly, scientists successfully hauled 5,000 to 10,000 fruit fly parasites per bag. Scientists tested the bags with mosquito-sized braconid parasites, and say they should work with other biocontrol insects as well.

*Insect Attractants, Behavior and Basic Biology Research  
Lab, Gainesville, FL*

*John N. Sivinski, (904) 374-5791*

## Human Nutrition

**Eating alone is the most common factor behind poor nutrition among older people.** That's according to a survey of nearly 700 volunteers from age 60 through their 90's—the latest of several studies to show this association. Other factors identified that contributed to poor nutrition, in order of their impact, were low education level, belonging to a racial minority, living in a low-income neighborhood, smoking, wearing dentures and taking multiple medications. To determine these factors, researchers ran statistical analyses on the survey volunteers who reported diets that met one or more of the following criteria; less than two-thirds of the Recommended Dietary Allowances for calories, vitamins or minerals; more than 40 percent of calories from fat; or more than 15 percent of calories from saturated fat. A low-calorie intake was the most frequent deficit among the women and was linked to eating alone, belonging to a racial minority and taking multiple medications. A high-fat or high-saturated-fat intake was the main liability among the men and was linked to eating alone, low education level and smoking. Smoking was also associated with a high-fat intake among the women.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Katherine Tucker, (617) 556-3351*

**Eating fish every day of the week can be too much of a good thing, over time.** A study shows it has the potential to depress immune function, leaving people more vulnerable to infections. Researchers put 22 volunteers on a low-fat diet (30 percent fat calories) for nearly six months. Half got most of their polyunsaturated fats from eating fish—tuna, salmon or filet of sole—at least once a day, while the other half got them from vegetables. By the end of the study, the fish eaters had a 46 percent weaker response to a skin hypersensitivity test, compared with their response at the beginning of the study. And their T-cells were 24 percent slower to multiply when challenged with a substance that promotes cell division. And some of the chemical signals that orchestrate a coordinated immune response were also significantly depressed. By contrast, the vegetable fat group had a significant increase in these chemical signals, compared to their initial test results, as well as an increase in specific lymphocytes. This runs counter to results of animal studies in which vegetable-derived polyunsaturated fats tended to suppress immune function. The findings should not discourage people from eating fatty fish several times a week as recommended. But those who eat an excess would be wise to get adequate levels of anti-oxidant nutrients, such as vitamin E and beta carotene, to counter the effects of fish oil.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Simin N. Meydani, (617) 556-3129*



**Methods for measuring fiber in foods** are far from foolproof—despite the new labeling requirement that total dietary fiber be listed on foods containing more than one gram per serving. An ARS chemist compared the method currently approved by the Association of Official Analytical Chemists (AOAC) with her own simplified method on both cooked and canned legumes. For the canned legumes, the two values were similar. But they differed two-fold for cooked legumes. Cooked chick peas, black beans, Great Northern beans, kidney beans and pinto beans had half as much fiber when measured by the simpler ARS-developed method. That's because some hard-to-dissolve starch remained in the samples prepared by the AOAC-approved method—giving a false high reading for fiber. This "resistant starch," however, dissolves at the higher temperatures used in canning so that the values from both methods agree. The study was prompted by the National Cancer Institute's request for more complete data on the fiber content of legumes, which are second to whole grain foods as an important source of fiber. Among the 17 different store or national brands analyzed by the simplified method, total dietary fiber ranged from 16 percent for chick peas and canned pork and beans to 29 percent for lima beans and kidney beans cooked at home.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Betty W. Li, (301) 504-8466*

**Eating extra dietary fiber did not interfere with minerals** in a 20-week study of 42 men. That finding should quell any concern over increasing fiber intake. It's well known that certain types of fiber can "handcuff" minerals in the intestinal tract and keep them from moving into the blood. So researchers compared the amounts of six minerals the volunteers retained in their bodies as they consumed both a high-fiber, low-fat diet and a low-fiber, high-fat diet for 10 weeks each. No significant difference was found in levels of calcium, iron, zinc, copper, magnesium and manganese. Actually, the two diets balanced out: The men lost more calcium, zinc, copper and magnesium through the stool while eating the high-fiber diet. But they also consumed more of these minerals through the extra cereals, legumes, fruits and vegetables. The high-fiber, low-fat diet supplied 55 grams of total fiber—nearly twice the 29 grams in the low-fiber diet—but had only half as many fat calories (20 percent versus 40).

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Kay Behall, (301) 504-8682*

**Does a high intake of fructose sugar magnify** the consequences of a low-zinc diet as it does for a low-copper diet? In rats' brains, at least, the answer is yes. A low-zinc diet is already known to alter the function of natural chemicals known as opiates that have hormone-like effects in human

and animal brains. So ARS researchers studied the combined effects of a high-fructose, low-zinc diet on opiate receptors. The animals raised on a marginal zinc diet containing no fructose showed some change in the receptors, they found. But the group raised on marginal zinc and high fructose showed much greater changes. By contrast, the groups that got adequate zinc had normal receptors, regardless of whether they got fructose or starch as the carbohydrate. Comparatively speaking, Americans ingest much less fructose than contained in these diets. And most get enough zinc. But the findings illustrate how table sugar and sweeteners—which are steadily increasing in the U.S. diet via processed foods and beverages—can interfere with the body's use of other nutrients. Table sugar is one-half fructose; high-fructose corn sweeteners are about 55 percent fructose.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Sam J. Bhathena, (301) 504-8422*

**Our bodies absorb and use more** members of the chemical family known as carotenoids than just beta carotene. And some of beta carotene's relatives may be just as important in preventing cancer due to their anti-oxidant capability, according to analyses of human blood. Just three years ago, only seven carotenoids had been found in human plasma. ARS research has identified 12 more, some of which are oxidation by-products of two commonly eaten carotenoids—lutein and zeaxanthin. The fact that they become oxidized themselves into benign compounds indicates they can protect cell molecules, including DNA. This supports the hypothesis that the anti-cancer potential of carotenoids is due to this anti-oxidant capability. Population studies have linked a high intake of fruits and vegetables rich in carotenoids with a lower risk of cancers of the lung, esophagus, colon, head and neck. These red, orange and yellow pigments give tomatoes, carrots and squash their distinctive colors. They're also abundant in dark green, leafy vegetables hidden by the green color of chlorophyll.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Frederick Khachik, (301) 504-8830*

**By restricting rats' food intake**, researchers again reduced the tissue damage and premature death caused by copper deficiency. This study, done at Beltsville, MD, and another reported last quarter from Grand Forks, ND, have uncovered another benefit of cutting calories. Normally, when young male rats are fed a copper-deficient diet containing high levels of sugar, they suffer damage to the heart and pancreas, become anemic and die prematurely. By reducing the food intake of growing male rats to the amount their female counterparts normally eat, the Beltsville scientists significantly reduced the symptoms of copper deficiency and kept all the rats alive during the 10-week study. It is very

difficult to conduct food restriction studies in people. But scores of such studies in test animals over several decades have prevented cancer and other age-related diseases as well as doubled the animals' life span.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Sam J. Bhathena, (301) 504-8422*

**Supplements of glutathione may boost older people's** flagging immune response, according to preliminary findings. The anti-oxidant glutathione—one of the most abundant simple peptides in humans and other living organisms—is a common dietary supplement in Japan but not in the United States. Researchers at this ARS center had earlier shown that another anti-oxidant, vitamin E, helps restore older people's ability to nip germs and would-be cancers in the bud. They wanted to see if extra glutathione could also improve the function of white blood cells, especially T-cells, where most of the age-related loss of immune response occurs. So they tested the peptide first in aging mice with successful results and then on white blood cells from both young and older people. Glutathione improved the cells' ability to divide and to produce substances that mobilize other players in the immune response. It also dampened the cells' production of inflammatory substances. And it had a greater effect on the more sluggish cells from the older people, boosting their function close to that of young people's cells. Researchers now want to test glutathione supplements in a human study.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA  
Simin N. Meydani, (617) 556-3129*

**Tracking molybdenum levels in the body** may be easier now that ARS scientists have identified two promising analytical procedures. Body enzymes use molybdenum to prevent toxic buildup of certain chemicals and to aid normal fetal development. Beans, peas and whole grains are the best sources of this little-known but essential mineral. One technique relies on enzymes; the other uses a special form, or "isotope," of the mineral. In the future, either of the two approaches might be incorporated into a simple urine test that physicians and nutritionists could use as part of a patient's nutrition check-up.

*Micronutrients Research, San Francisco, CA  
Judith R. Turnlund, (415) 556-9697*

### **New and Improved Products**

**Natural fungal enzymes can help extract soluble glucose,** sucrose, fructose and other sugars from orange peels. These sugars can be used to produce organic acids and alcohols which are used in products like gasoline, rubbing alcohol, alcoholic beverages, soft drinks, food and perfumes. Up to 60 percent of the weight of fruit ends up in waste peel,

segment membranes and other byproducts. In Florida, orange and grapefruit processing generates about a million dry tons of citrus peel, cores, membranes and seeds annually. This waste is now used to feed cattle and sells for only four to six cents per pound. Although readily digestible, citrus peel is low in protein, which reduces its value as cattle feed. Much energy is required to produce the heat necessary to turn the peel waste into dry feed. However, very little time and effort are required for the enzymes to produce the sugars from the peels.

*Citrus and Subtropical Products Laboratory,  
Winter Haven, FL*

*Karel Grohmann/Elizabeth A. Baldwin, (813) 293-4133*

**Processed orange juice can now taste** more like freshly squeezed juice, thanks to a new computer program that pinpoints the precise mix of flavor components that make up an orange's fresh taste. ARS scientists earlier had identified 20 flavor components found in fresh orange juice, and then determined the amount of each in the four main types of orange juice products. They developed a computer program that calculates the proportion of these flavor components in the orange juice products. Citrus processors can use the program to determine how close the flavor of their juice is to that of freshly squeezed orange juice. The program can also show which flavor fractions to add to juice products to make them more nearly match the taste of fresh orange juice.

*U.S. Citrus and Subtropical Products Laboratory,  
Winter Haven, FL*

*Philip E. Shaw, (813) 293-4133*

**Roasting whole soybeans can ensure** that dairy cows get maximum nutritional benefit from the roasted beans. But doing it correctly is crucial because undercooked beans don't supply the kind of protein animals need for digestion. Overcooking leaves this protein unavailable for absorption. ARS researchers pinpointed the optimum temperature and cooking times for properly roasting whole soybeans. Also, tests showed that Holsteins produced three to five pounds more milk per day when fed properly roasted beans. Now, the researchers are building a new roasting machine to help industry meet the new soybean-roasting procedures.

*U.S. Dairy Forage Research Center, Madison, WI  
Larry D. Satter, (608) 263-2030*

**Soybean hulls, rice hulls, rice bran and sugarbeet pulp** all will bind metals and other industrial wastes so they can be removed from water, making each of these agricultural byproducts useful in wastewater treatment. Laboratory tests showed these inexpensive natural products may be used in cleanup only a few times because they break down rapidly. But that same easy breakdown means the materials will not pose an environmental problem of their own. Industry and wastewater treatment plants currently use



commercially available resins that may be used repeatedly for nearly a year, but the resins create a disposal problem of their own.

*Food Physical Chemistry Research, Peoria, IL*  
*Joseph A. Laszlo, (309) 685-4011*

**Water-absorbing cornstarch and corn flour** in semi-flexible polyurethane foams make the foams ideal as seedling starter beds for fruits, vegetables and flowers. ARS tests indicate regular corn flour and/or unmodified cornstarch may be included in foam formulations at levels up to 50 percent, providing foams with suitable moisture retention for plants. Alternatively, cornstarch or corn flour cooked to form a gelatin can be used. Foams consisting of 16 percent gelatinized corn flour absorbed water faster and drained better than foams without a corn product, but retained only about half as much water. ARS plans to seek a patent on the foam.

*Food Physical Chemistry Research, Peoria, IL*  
*R. Leo Cunningham, (309) 685-401*

**Painting peanut warehouse roofs white** is an inexpensive and effective way to reduce kernel-moisture loss caused by high temperatures. ARS scientists found that the white roofs lower temperatures by as much as 40 to 50 degrees F. It's important that kernel moisture not fall below seven percent because dry peanuts tend to split or crack and are harder to roast evenly. Reduced moisture content also increases milling losses. Researchers checked temperatures for three years on galvanized metal panels of white latex paint, white ceramic paint and uncoated panels. Scientists initially thought white ceramic would perform best because it was reported to have the insulating qualities of the ceramic tiles used in the space industry. But the studies showed that latex paint worked as well as the more expensive ceramic paint at reflecting the sun's rays and that neither had much insulation value. Surface temperatures of peanuts stored in a non-painted warehouse can reach 115 degrees F. But if the warehouse roof is painted white, those surface temperatures drop to about 95 degrees F.

*National Peanut Research Laboratory, Dawson, GA*  
*John S. Smith, (912) 995-4481*

**Sensors mounted on a plane** could be a practical, economical tool to help limit off-flavor problems in farm-raised catfish. Off-flavor problems cost catfish farmers approximately \$12 million per year in lost production. ARS scientists say a technique called remote-sensing imagery gives a reliable estimate of algae activity in catfish ponds. Rapid growth and death of blue-green algae causes sudden deterioration of water quality and production of off-flavor compounds. Researchers are correlating images from remote-sensing equipment with mathematical calculations based on actual experiments to determine the various stages of algae growth and health. Sensors record wave lengths

which are translated into specific pigments. The color and amount of pigments indicate the type of algae present in the pond, their numbers and health.

*Food Flavor Quality Research, New Orleans, LA*  
*Peter B. Johnson/David F. Millie, (504) 286-4461*

**A food processing machine that makes alphabet noodles** for soup and other shapes for cereals will be given a new job by ARS scientists—to turn out food for lab-reared pink bollworms. Pink bollworms are mass-reared and sexually sterilized in labs and then released to protect cotton in California's San Joaquin Valley. No offspring result when the sterile bollworms mate with wild, fertile partners. Now, ARS scientists have shown that the food processing machine—called an extruder—saves time and money in preparing feed for these insects. Sterile bollworms have been mass-reared for more than 20 years to protect San Joaquin cotton fields. ARS scientists were the first to test an extruder for making insect food. It mixes, cooks and shapes the insects' pasta-like food into tiny tidbits, reducing labor costs by an estimated 70 percent. USDA's Animal and Plant Health Inspection Service plans to use an extruder for rearing one billion sterile pink bollworms each year.

*Cereal Products Utilization Research, Albany, CA*  
*Richard H. Edwards, (510) 559-5852*

**Pickle research has given winemakers** a new way to test the quality of their wine. Adapted from a method developed by ARS researchers to analyze acids and sugars in fresh cucumbers and pickles, the new test allows organic acids, sugars and alcohols to be analyzed simultaneously. Wine taste and quality depend in part on the right mix of these compounds. Winemakers can determine the amount of each compound in their product. But this refined version of a technique called high-performance liquid chromatography is a more accurate—and faster—way to measure these critical compounds. Also, the new test could eliminate some problems the wine industry encounters when the compounds are considered separately.

*Food Science Research, Raleigh, NC*  
*Roger F. McFeeters, (919) 515-2979*

**New lab procedures can extract many pesticide residues** from food samples in minutes instead of hours. Many current methods require an entire day and large amounts of hazardous solvents. But the new ARS-developed procedures take only five minutes and use small amounts of water or other safe solvents. Lab analysts have used the procedures with commercial ELISA kits to detect the herbicide alachlor and the insecticides aldicarb and carbofuran in milk, meat, liver and eggs at the 10-to-50 parts-per-billion tolerance levels set by the U.S. Environmental Protection Agency.

*Environmental Chemistry Laboratory, Beltsville, MD*  
*Steve J. Lehotay, (301) 504-8904*

## Crop Production and Protection

**Herbicides can be reduced 75 percent** on no-till corn fields by doubling the number of plants and narrowing the rows from 30 to 15 inches apart—without sacrificing yields. Atrazine and metolachlor were applied on soil at one-fourth the recommended rate before corn seedlings emerged. Scientists reported that the higher density of corn plants crowded out weeds by blocking out sunlight. The approach could save farmers money and reduce the impact of herbicides on ground and surface water. Corn accounts for about 40 percent of the 500 million pounds of herbicide used each year on U.S. cropland, with atrazine and metolachlor among the top three.

*Weed Science Lab, Beltsville, MD*

*John R. Teasdale, (301) 504-5504*

**Relief from the alfalfa weevil**, a serious pest of U.S. alfalfa, may come from wild Turkish plants. Currently, no varieties of alfalfa (*Medicago sativa* L.)—a major forage for livestock—resist the weevil (*Hypera postica* [Gyllenhal]), although some can tolerate feeding by larvae. New sources of alfalfa, collected by ARS scientists in Central and Eastern Turkey in 1981, have been screened for resistance in the lab. Among the wild sources, ARS scientists found a promising level of resistance in five of about 80,000 plants screened. After five to seven days, feeding and egg laying rates by female weevils eating these plants were decreased significantly, compared with a susceptible variety (Ranger) during the same period. These plants did not affect survival rate of larvae or adults but both stages of insects ate less. Further research is needed to determine the value of these plants for developing an alfalfa line with resistance that can be used to develop new varieties.

*Insect and Weed Control Research, West Lafayette, IN*

*Roger Ratcliffe, (317) 494-4606*

**For the first time, scientists have discovered** master genes, known as homeobox genes, in plants. ARS scientists found the first homeobox gene in corn, and then identified similar genes in other plants. A homeobox gene contains a section—the homeobox—that controls other genes. Scientists hope to use homeobox genes to uncover secrets about plant growth. The new knowledge could lead to ways to drastically change a plant's architecture and perhaps boost yield. One possibility: corn plants with short, squat stalks that can support more ears than today's tall, slender cornstalks. Researchers elsewhere have used the homeobox from the corn gene to isolate homeobox genes in other crops, including rice, tomatoes, barley and peas.

*Plant Gene Expression Center, Albany, CA*

*Sarah C. Hake, (510) 559-5900*

**A new plant protein discovered by ARS scientists** appears to serve as a master switching station, relaying phytochrome's orders to the plant's genes. Phytochrome senses light and orders plants when—and when not—to sprout, grow and flower. It may be possible to genetically rebuild the protein, thereby changing phytochrome's commands—and perhaps creating crop plants that grow on timetables more useful to farmers. One potential payoff: crop seeds that sprout sooner than weeds. With this head start, crops might beat weeds in the race for light, nutrients and room to grow—and thereby reduce the need for weed-killing chemicals. Researchers found the protein—it's named COP1 (for constitutively photomorphogenic)—in a mustard relative, *Arabidopsis thaliana*.

*Plant Gene Expression Center, Albany, CA*

*Peter H. Quail, (510) 559-5900*

**A new peach rootstock resists** peach tree short life (PTSL) disease. This disease, which costs peach growers millions of dollars in losses annually, is caused by the ring nematode which lives in the soil. Affected trees suddenly wilt, give off a sour-sap odor and die shortly after bloom. Trees grafted onto seedlings of the resistant rootstock were planted on a site known to be infested with the ring nematode. After five years, none of the trees on the new rootstock had died. In contrast, 70 percent of the trees on Lovell and 90 percent of the trees on Nemaguard—both standard commercial rootstocks—had died from PTSL. Chemical control has been used for the underground pest, but nematicides and fumigants are very expensive and soon may not be available because of environmental concerns. Seed of the new rootstock, developed by ARS and Clemson University scientists, should be available to nurseries this coming year.

*Southeastern Fruit and Tree Nut Research Lab,*

*Byron, GA*

*Tom Beckman, (912) 956-5656*

**Soil tests in potato fields** can put more money in growers' pockets in two ways: higher quality spuds and lower fertilizer cost. New findings indicate the tests benefit growers more than commonly believed. ARS scientists say growers of irrigated Russet Burbank potatoes—the most popular variety in the Pacific Northwest—should test the soil to learn the minimum amount of fertilizers the crop needs. Applying too much nitrogen and potassium causes the tubers to weigh less and be less valuable at market. Scientists also found that potato quality drops if growers apply the chloride form of potassium when not enough nitrogen is available to the plants. To avoid that problem, the scientists recommend soil tests to ensure that the correct amount of nitrogen is applied with the chloride or sulfate form of potassium.

*Soil and Water Management, Kimberly, ID*

*Dale T. Westermann, (208) 423-6566*



Two new garbanzo bean varieties resist the fungal blight that wiped out half the garbanzo harvest in the Pacific Northwest six years ago. ARS researchers developed the varieties, Dwelley and Sanford, for Washington and Idaho where the *Ascochyta* fungal blight hit hardest and where the fungus has been a continuing problem. Scientists say the varieties could soon restore the Washington and Idaho acreage to pre-blight levels, and perhaps even exceed them. These states plus Oregon and California produce most of the nation's garbanzo crop, worth about \$4 to 5 million. Rich in fiber, garbanzos serve as an excellent source of two essential protein components—the amino acids lysine and tryptophan. The new cream-colored garbanzos have deep creases, which food processors like. Creases let garbanzos fatten nicely but stay firm when cooked in water at the cannery.

*Grain Legume Genetics Research, Pullman, WA*

*Frederick J. Muehlbauer, (509) 335-9521*

*Plant Germplasm Introduction Research, Pullman, WA*

*Walter J. Kaiser, (509) 335-1502*

A new soybean line could help reduce off-flavors and rancidity in soybean oil. BARC-12, the new line developed by ARS researchers, can be used to breed soybean varieties that have less linolenic acid. That's the fatty acid in soybean oil that causes flavor and quality to decline and reduces shelf life. In BARC-12, linolenic acid is only 3.1 percent of the total fatty acid content, compared to eight percent in standard soybeans processed for oil. That lower fatty acid total was confirmed in fatty acid analysis of oil in beans harvested from test plots.

*Soybean and Alfalfa Research Lab, Beltsville, MD*

*Robert C. Leffel, (301) 504-6722*

Barley breeding lines can be screened for resistance to Russian wheat aphids as early as one day after aphids start feeding on the leaves. That's the fastest plant response to Russian wheat aphids found so far. Normally, three weeks are needed. What triggers the quick identification are "needle tracks" left in the leaves by the aphids' piercing mouthparts. ARS scientists found that under ultraviolet light microscopy, leaves of resistant plants had more collapsed cells near the needle tracks than did leaves of susceptible plants. This phenomenon previously had been seen only when plants defended themselves against microbial pathogens. The new autofluorescence technique can speed the screening of aphid-resistant barley and may help researchers understand the biochemistry involved in plants' response to insect attacks.

*Wheat and Other Cereal Crops Research, Stillwater, OK*

*Helen Belefant-Miller, (405) 624-4251*

Newly established pine plantations can get a non-chemical, helping hand from goats in fending off weedy competition. In trials following timber harvest in Arkansas'

Ouachita National Forest, shortleaf pines were hand-planted in December 1990. Some of the pine seedlings were subsequently protected from weed competition by herbicide applications. Others were left to fend for themselves, and a third group's area was grazed by Alpine or Angora goats from April to September. At the end of the crucial first year of the pines' growth, only 14 percent of competitive ground cover remained in the areas grazed by the goats—more than the four percent left behind by the herbicide treatment, but less than the 20 percent ground cover remaining in the untreated area. While some seedlings were grazed by the goats, only three percent of seedling mortality in the establishment year was attributed to the goats; 97 percent of mortality was due to natural causes. Pine seedling survival in the goat treatment was as good or better than normal survival rates in the forest, plus the goats gained weight—from four to 11 percent—during their summer forest grazing.

*South Central Family Farms Research Center,  
Booneville, AR*

*Henry A. Pearson, (501) 675-3834*

A fatal case of indigestion can await insect pests that gnaw on genetically-altered plants. An enzyme in the plants apparently triggers the reaction. ARS scientists discovered a new insect-resistance mechanism that can be transferred through genetic engineering of plants. Ohio State researchers genetically modified tomato and tobacco plants to overproduce the enzyme, which causes rapid browning when insects start to damage the plants. ARS greenhouse and laboratory studies found that 90 percent of corn earworms and dusky sap beetles died after feeding on the plants. Researchers suspect the browning enzyme makes plant tissue tougher, indigestible and toxic. Sap beetles reduce yields of fruit and grain crops such as figs, peaches and corn. They also spread unwanted fungi, such as *Aspergillus flavus*, which produces aflatoxin in corn. Corn earworms infest corn, cotton, tomatoes and other crops causing an estimated \$1.2 billion in damage each year.

*Mycotoxin Research, Peoria, IL*

*Patrick F. Dowd, (309) 681-6242*

Hessian flies in the future may have a harder time adapting to resistant wheat. That's been the pest's "ace in the hole." A new wheat variety is bred to resist the flies, but sooner or later they adapt and start feasting on it. Now ARS scientists have, for the first time, pinpointed how wheat plants respond to pest infestation. When Hessian fly larvae feed on the lower leaf of seedling wheat plants, resistant plants react by limiting the insect's ability to permeate cells. The ability appears to be linked to increases in certain proteins in resistant plants. From this work, it is now known that hypersensitivity in wheat forms the basis of Hessian fly resistance—a finding that can be very useful in orienting future research on the poorly understood subject of

Hessian fly-wheat interactions. It will also help future genetic engineers to enhance pest resistance in wheat, making it harder for the pest to adapt.

*Insect and Weed Control Research, West Lafayette, IN*  
Richard H. Shukle, (317) 494-6351

Sweetpotato whiteflies would rather eat green than red cabbages. That's true of other cole crops. They also prefer plants that have waxy leaf surfaces, ARS scientists found in studies of plant characteristics that could play a future role in controlling whiteflies. A destructive pest of about 500 crops, the whitefly is resistant to insecticides. Scientists ran small-scale lab and field studies of 70 varieties of cole crops—including kale, collards, cabbage, Brussels sprouts, kohlrabi and broccoli. About 90 percent fewer whiteflies attacked red varieties than green ones. Also, plants with glazed, low-wax leaves attracted fewer flies. That's probably because the lower levels of wax cause the whiteflies to leave the plant, rather than remain on it to lay eggs. Scientists say breeders should take color and levels of leaf wax into account when screening germplasm for breeding varieties resistant to the pest.

*U.S. Vegetable Laboratory, Charleston, SC*  
Kent D. Elsey/Mark W. Farnham, (803) 556-0840

Three proteins from blueberry buds that seem to correlate with cold hardiness have been isolated by ARS scientists searching for a more versatile blueberry. Quantities of the proteins increase when the plants become dormant—the time when plants ready themselves for colder temperatures. Protein levels drop when the buds open and temperatures are warmer. The proteins have been purified and one has been identified as cyclophilin, a substance found in all living organisms. In humans, this protein binds to the drug cyclosporin (an immunosuppressant) and suppresses the immune system. It is not yet known what it binds to or what its exact role may be in the cold hardiness of blueberries. The proteins were found while scientists were analyzing DNA samples to complete the first genome map for the blueberry plant.

*Fruit Laboratory, Beltsville, MD*  
Lisa J. Rowland, (301) 504-6654

Two newly named strawberry varieties—Redgem and Bountiful—have been developed by ARS scientists and are available in-season for planting from some Pacific Northwest nurseries. Berries from both plants keep their original color, texture, and shape after thawing, making them ideal for use in either frozen or processed foods like ice cream, frozen pies, or yogurt. Other advantages: Redgem may appeal to backyard gardeners and local fresh-market growers in Oregon, Washington, and Idaho. Bountiful is a candidate for mechanical harvesting because most of its berries can be gathered with only two harvests; most commercial strawberry varieties require three or more

pickings because the fruit ripens at different times. Last year, Pacific Northwest growers harvested 72 million pounds of strawberries, worth about \$26 million.

*National Clonal Germplasm Repository, Corvallis, OR*  
Francis J. Lawrence, (503) 750-8712

## Animal Production and Protection

A natural compound probably present only in insects helps mosquitoes escape their victims without becoming victims themselves. When a female mosquito fills up on blood, her weight more than triples, and her flying and escape abilities are impaired. Fortunately for her, most of the weight of the bloodmeal is water and salt. ARS researchers, in collaboration with scientists at Texas A&M University and Cornell University, have isolated from mosquitoes a compound called culexinin depolarizing peptide (CDP). This peptide stimulates the mosquito to urinate as she feasts, allowing her to shed up to 90 percent of her newfound weight and make good her escape. The researchers will seek natural pest control agents that would mimic CDP's stimulation of urination by insects, giving the pests a fatal case of diarrhea as the insect "kidney" empties into the gut. They also plan to develop synthetic versions of the peptide to attack the insect "kidney" and nervous system to control mosquitoes and other pests.

*Food Animal Protection Research, College Station, TX*  
G. Mark Holman, (409) 260-9322  
*Department of Entomology, Texas A&M University, College Station, TX*  
Timothy K. Hayes, (409) 845-8315

To speed development of poultry for selected traits, researchers are making a genetic map of the chicken. So far, more than 220 DNA segments known as genetic markers have been placed on the map. Genetic markers, like mile markers along a highway, allow scientists to more accurately pinpoint the location of genes that control valuable traits such as disease resistance or meat quality. Markers lie at intervals along 39 pairs of chromosomes in the chicken. The major project goal is to map 100 to 200 evenly-spaced genetic markers that can be easily used to find genes for agriculturally important traits. About 30 of these "landmark" genetic markers have been discovered. When the map is completed, poultry breeders will have the ability to know precisely where to check on the chromosomes for the presence of genes that control specific traits, as well as know which birds possess the desired genes.

*Avian Disease and Oncology Research, East Lansing, MI*  
Hans H. Cheng, (517) 337-6758

Shrinking excess fat from broiler and roaster chickens would be welcome news for health-conscious consumers.



ARS scientists have targeted a hormone called pancreatic polypeptide, which they believe changes the ratio of proteins in cells to stimulate the breakdown of fat. Preliminary results suggest it may be possible to eventually identify the genes responsible for accumulating excess fat in chickens. This could lead to genetically engineering chickens to produce less fat. Getting rid of excess fat in the birds' abdomens, for example, could save farmers \$500 million in feed annually.

*Poultry Research, Georgetown, DE*  
*Thomas P. Oscar, (302) 856-0046*

**Dark-colored hives help protect bees** against honeybee tracheal mites. That's because those nasty mites can't take the higher temperatures inside the dark hives, which absorb more sunlight. In field and lab studies, a temperature of 102 degrees F didn't harm bees but killed the mites. Tracheal mites have caused the loss of 50,000 honey bee colonies each year since 1988. After a three-month study, researchers found only one in 12 mite-infested colonies in dark hives still had mites, while 10 of 12 colonies in white hives remained infested. Lab tests confirmed that exposure for 48 hours at 102 degrees F significantly cut populations of mite larvae and eggs. Scientists say the reason may be that when hive temperatures rise, bees try to cool the hive by fanning their wings. This causes heat inside the bee to rise because of the action of wing muscles located near the bee's breathing tubes, where the mites live. One recommendation from the study: If honeybees are being bred for tracheal mite resistance, they should be kept in white hives or in the shade, so that heat and other environmental effects do not mask genetic resistance to the mites.

*Honey Bee Breeding, Genetics and Physiology Lab,*  
*Baton Rouge, LA*  
*John R. Harbo, (504) 766-6064*

**An artificial stomach is helping scientists** delve into the secrets of cattle digestion. Their findings could help pinpoint whether urea, a compound converted to ammonia after being consumed by cattle, would increase bacterial activity in the rumen or stomach—important for digestion—while preventing production of too much ammonia. Nitrogen from feed is transformed into ammonia that is wasted, instead of being turned into meat. The artificial stomach also will allow more accurate measurement of the types of bacteria that aid digestion. Using the artificial stomach reduces the number of animals needed for digestion experiments, although it cannot totally replace the natural stomach in research. Similar rumen research has showed farmers how to improve cattle's digestion of fibrous material in corn silage by adding sodium bicarbonate to the diet to lower rumen acidity.

*Ruminant Nutrition Laboratory, Beltsville, MD*  
*Leonard L. Slyter, (301) 504-9436*

**If one pill is good, two is better** when battling dung-breeding horn flies and face flies that plague cattle. That was the finding when ARS researchers developed and evaluated slow-release boluses or pills containing pyriproxyfen, an insect growth regulator. In field tests in Maryland and Texas, the researchers found boluses went to work faster in the cow's stomach when the animal was given two rather than one. This dosage prevented more than 90 percent of horn flies and face flies from developing into adults, and cattle were protected for 10 weeks.

*Livestock Insects Laboratory, Beltsville, MD*  
*Richard W. Miller, (301) 504-8478*  
*Knipling-Bushland U.S. Livestock Insects Research*  
*Laboratory, Kerrville, TX*  
*J. Allen Miller, (512) 792-0318*

## Soil, Water and Air

**ARS scientists have found** that the tire industry's new minimum pressure—designed to lessen a vibration problem with radial tires—also helps reduce soil compaction. The industry minimum for radial tires was recently reduced from 12 to six pounds per square inch (psi). Scientists placed sensors at key locations in the soil and on the tire tread and ran the tire through its paces at different pressures and loads. At six psi, the tire spread the load over a larger area of soil, reducing soil compaction. To achieve this benefit, however, farmers must know the load on their tires and use the industry's new pressure-load tables to set the correct pressure. Farmers may not be able to use the minimum of six psi on some tractors without purchasing larger tires.

*National Soil Dynamics Laboratory, Auburn, AL*  
*Alvin C. Bailey/Randy L. Raper, (205) 887-8596*

**To avoid overapplying fertilizer**, "Snow Belt" farmers who sample soil in the spring for nitrate-nitrogen should test down to three or four feet rather than the usual foot or so. ARS researchers came to that conclusion after finding a few surprises about water movement over winter. Water moves up and down through frozen soil via wormholes and cracks or by merging with an unfrozen film of water around soil particles. Freezing soil acts like a dry sponge, sucking up water from underlying soil. In the spring, additional water from snowmelt and rainfall accumulates above frozen subsoil. This creates a supersaturated surface. When the soil completely thaws, water stored for weeks or months is released and moves another foot or two down. This can place nitrate and pesticides three to five feet below the surface. Corn roots can still reach nitrate at that depth.

*North Central Soil Conservation Research Laboratory,*  
*Morris, MN*  
*James A. Staricka, (612) 589-3411*

Two years of research show that the impact of tillage practices on water quality in the Midwest can be improved by changing them. It's part of USDA's five-year Midwest Water Quality Initiative, focusing on Iowa, Minnesota, Missouri, Nebraska, Ohio, North and South Dakota and Wisconsin. These states, along with Illinois and Indiana, produce 80 percent of the nation's corn and soybeans and are primary users of fertilizer and pesticides that could pollute ground and surface water supplies. ARS scientists found water quality can be improved by decreasing the concentrations of the herbicides atrazine, metribuzin, alachlor, metolachlor and nitrate leached below the root zone, and by controlling surface water runoff so no chemicals are lost from the field. The goal of the initiative is learning how to reduce leaching and wash-off of chemicals and at the same time produce a profitable crop. Research and education programs will lead to voluntary adoption of alternative agricultural systems and technologies to help farmers accomplish this goal while reducing any adverse impacts on water resources.

*National Soil Tilth Laboratory, Ames, IA*  
*Jerry Hatfield, (515) 294-5723*

Crop residue management techniques, now being used on more than half the nation's cropland, will stop rainstorms from carrying away tons of soil an acre on sloping fields. The confirmation that a few storms of one inch to six or more inches of rainfall do most of the erosion damage on bare fields comes from 21 years of research at Watkinsville, GA, and 30 years of research at Coshocton, OH. Both studies confirm the long-term benefits of not plowing under a protective layer of stems and stalks after harvest. In the first two years of the 21-year study, four rainstorms washed away 99 percent of the 12 tons of soil per acre lost to date. Then scientists began testing new tillage tools that allowed planting soybeans or grain sorghum directly into the remnants of a winter crop of wheat, barley, forage sorghum or crimson clover. Erosion slowed to a halt: Even a storm of more than six inches in 24 hours failed to move more than nine pounds of soil per acre off the fields. Scientists at both labs assisted in the development of the ever-growing array of special planters commercially available to farmers who want to plant seeds through crop residue. Farmers increasingly are choosing crop residue management to meet the voluntary soil erosion standards of the 1990 Farm Bill.

*Southern Piedmont Conservation Research Center,*  
*Watkinsville, GA*  
*George W. Langdale, (706) 769-5631*  
*North Appalachian Experimental Watershed Laboratory,*  
*Coshocton, OH*  
*William M. Edwards, (614) 545-6349*

Cotton yields were increased in a two-year test when an early-season, winter rye cover crop was used with minimal plowing to keep moisture in coarse-textured soils of the

Southeastern Coastal Plain. Cotton lint yields averaged an increase of 293 pounds an acre, compared to harvests on fields left fallow during winter. The surface mulch left from the cover crop boosted yields by helping retain moisture in the soil from rain that fell during the cotton growing season.

*Coastal Plain Soil, Water and Plant Conservation*  
*Research, Florence, SC*  
*Philip J. Bauer, (803) 669-5203*

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# Quarterly Report

of Selected Research Projects October 1 to December 31, 1993

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## Into the Marketplace

### Patent Licenses

...To **Franks Research Laboratories, Inc., Oklahoma City, OK**, to make and sell ink products based on ARS-patented technology to produce 100-percent, vegetable oil-based ink. The nonexclusive license permits the company to sell products in Arkansas, Kansas, Missouri, Oklahoma and Texas. Suitable vegetable oils include soybean, cottonseed, corn, sunflower and other agricultural oils. ARS patented the technology in 1992. In 1993, ARS scientists tested the biodegradability of their soy ink vehicle—the fluid portion of the soybean ink minus the pigment. A high level of biodegradability means, for example, that oil-based ink in printed materials such as newspapers would not pose an environmental problem if the materials were disposed of in a landfill. On average, 90 percent of the ARS soy ink vehicle degraded in 25 days, compared with an average 60 percent of a soy ink vehicle used by the Newspaper Associa-

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

The report is now available in several electronic formats.

Items marked with the word **PATENT** are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.

tion of America. The NAA formulation contains about 30 percent soy oil. Least degradable was a petroleum-based vehicle, which averaged 22 percent degradability. (PATENT 5,122,188)

*ARS Contact: Sevim Z. Erhan/Marvin O. Bagby, Oil Chemical Research, Peoria, IL, (309) 681-6531*

...To **Berry Citrus of Winter Haven, FL**, to use an ARS-patented process to remove the peel, including the albedo, from oranges and grapefruit. Albedo is the white, spongy portion of the peel that clings to the fruit. A natural enzyme called pectinase removes the peel and albedo, leaving fruit intact without any loss of juice. Previously, citrus sections were obtained by steaming, machine peeling and soaking the fruit in hot lye, then cutting it by hand—which could waste juice and adversely affect flavor. Now the enzyme process yields nutritious, uncut, whole fruit and sections without any loss of flavor or juice. (PATENT 4,284,651)

*ARS Contact: Robert A. Baker, Citrus & Subtropical Products Laboratory, Winter Haven, FL, (813) 293-4133*

### Cooperative Research and Development Agreements

...With **Peninsu-Lab, Poulsbo, WA**, to commercialize the beneficial *Cryptococcus laurentii* yeast and other microorganisms that might protect tree seedlings from gray mold and other diseases. That should enable nursery managers to use less chemical fungicides and reduce workers' exposure to them. Peninsu-Lab researchers have shown that the yeast helps shield nursery-grown, Douglas-fir seedlings: New experiments will determine whether it protects western red cedar, ponderosa pine and hemlock—other species susceptible to gray mold. Each year, gray mold causes an estimated \$2 million in losses to nurseries in the Pacific Northwest that produce seedlings for Christmas tree farms, logged timberlands and other sites.

*ARS Contact: Rodney G. Roberts, Tree Fruit Research Laboratory, Wenatchee, WA, (509) 664-2280*

...With **United Agricultural Products, Inc., of Greeley, CO**, to evaluate the potential of bacterial biocontrol strains to halt dry rot in stored potatoes. Dry rot, caused by the fungus *Fusarium sambucinum*, normally ruins five to 20 percent of the potatoes and can infect up to 60 percent. The fungus gains entry through wounds in the potatoes' skin and is often able to resist current chemical controls. ARS researchers have applied for a patent on the use of several

bacterial strains that show promise for limiting or preventing the disease. Four of these bacteria will be tested in large-scale trials performed under commercial storage conditions. (PATENT APPLICATION 08/068/872)

ARS Contact: David A. Schisler, Fermentation  
Biochemistry Research, Peoria, IL, (309) 681-6284

...With W.R. Grace and Company of Columbia, MD, to develop neem by-products for their fungicidal properties. Seed oil and wax extracts from the neem tree have been shown to protect several ornamental crops against fungus diseases such as rusts and powdery mildew that attack leaves. A product registration application for neem oil as a fungicide has been submitted to the Environmental Protection Agency. Previously, neem-based products were developed for insecticide use.

ARS Contact: James Locke, Florist and Nursery Crops  
Laboratory, Beltsville, MD, (301) 504-6413

## Human Nutrition

A new study provides more evidence that blood levels of beneficial HDL cholesterol rise in step with blood levels of vitamin C—at least to a point. Researchers analyzed blood samples from 477 men and women between the ages of 20 and 65 and compared their cholesterol profiles with vitamin C levels. Among the women, HDL cholesterol increased along with vitamin C levels until the vitamin reached one milligram per deciliter—easily attainable by consuming five fruits and vegetables daily. Then HDL leveled off. Among the men, by contrast, HDL cholesterol continued to increase linearly as blood vitamin C levels increased. What's more, higher vitamin C levels in the men were associated with lower total cholesterol and LDL cholesterol—the damaging kind—as well as a more favorable ratio of total cholesterol to HDL cholesterol. This is the first time researchers have seen a gender difference in vitamin C's effect on cholesterol levels out of many such studies. And they have no explanation for it. They went on to test the effects of supplementing the individuals with the lowest blood vitamin C levels. Results are expected later this year.

Human Nutrition Research Center on Aging at Tufts,  
Boston, MA

Paul F. Jacques, (617) 556-3322

Tooth loss may be an important early warning of bone loss in women as they age, according to a study of 329 women past menopause. The findings suggest that dentists may become key in identifying high-risk women before they develop osteoporosis. In the study of women, bone loss correlated directly with tooth loss: The more teeth they had lost the less bone they had in the spine, wrist and hip—the three areas most prone to fractures from osteoporosis.

Overall, tooth loss increased in line with the women's age and history of cigarette smoking. As the level of education rose among the women volunteers, the loss of teeth declined.

Human Nutrition Research Center on Aging at Tufts,  
Boston, MA

Elizabeth Krall, (617) 556-3074

It doesn't matter which of three kinds of oils is used in a cholesterol-reducing diet, once saturated fat is out of the picture. That's according to a four-month study of men and women who began with moderately high cholesterol levels. Researchers compared corn oil (high in polyunsaturated fat), canola oil and olive oil (both high in mono-unsaturated fat) as the primary fat in the National Cholesterol Education Program's Step 2 diet. This diet calls for fat intake to be less than 30 percent of total calories, with saturated fat less than seven percent. The 15 volunteers consumed the diet enriched with each oil for five weeks each. Reductions in their "bad" LDL cholesterol were not statistically different—17 percent for corn oil versus 16 percent for canola oil and 13 percent for olive oil. And contrary to some reports that monounsaturated fat "spares" the "good" HDL cholesterol, it dropped seven percent with canola oil—about the same as the nine percent drop with corn oil.

Human Nutrition Research Center on Aging at Tufts,  
Boston, MA

Alice H. Lichtenstein, (617) 556-3127

Volunteers in the first human study of ARS-developed Oatrim not only had a drop in cholesterol, they also lost weight, averaging 4.5 pounds. That happened even though their calorie intake increased during the study in an effort to stem weight loss. Also, their glucose tolerance—the ability to process sugar from a meal—improved, reducing the risk of diabetes. About one-half cup of Oatrim a day added to a variety of foods significantly reduced artery-clogging LDL cholesterol in the 24 volunteers, who were selected because of their mildly elevated cholesterol. But it did not lower the beneficial HDL cholesterol. Oatrim consists of amyloextrin—shortened fragments of starch—and beta glucans, the principal fiber in oats and barley that gives these grains their cholesterol-lowering property. ARS has licensed Oatrim to a joint venture between ConAgra and A.E. Staley and to a partnership between Quaker Oats and Rhone Poulenc. ConAgra puts Oatrim in several of its Healthy Choice products. And the Quaker Oats/Rhone Poulenc partnership expects to have several products containing Oatrim out this year.

Beltsville Human Nutrition Research Center,  
Beltsville, MD

Judith Hallfrisch/Kay Behall, (301) 504-8396/8682



**A significant number of older people** may need more of three B vitamins than they now consume to protect against heart disease and stroke. In a study of 1,160 elderly, nearly 30 percent had high blood levels of the amino acid homocysteine—known to contribute to blocked arteries in the heart and brain. And two-thirds of those with high homocysteine—or 20 percent of the study group—were below the group average in at least one of three B vitamins—folate (folic acid and its relatives), vitamin B6 or vitamin B12. Too little of these vitamins can cause a buildup of homocysteine. But people can get the amounts needed from foods. Liver and kidney are the richest sources of all three vitamins. Dark green leafy vegetables are an excellent low-fat source of folate. Researchers analyzed blood samples of men and women—67 to 96 years old—and estimated the participants' vitamin intakes from dietary questionnaires. Those who had the lowest blood levels or the lowest intakes of the three B vitamins were six times more likely to have high homocysteine than those taking the highest vitamin totals.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Irwin H. Rosenberg/Paul Jacques, (617) 556-3330/3322*

**Very premature infants have a better outlook** for strong bones if they get more calcium and phosphorus in their intravenous feedings shortly after birth. The bones of premature babies fracture easily because of low-mineral content. That's one of many consequences of trying to develop organs and systems outside the mother's uterus. Researchers dissolved 35 percent more calcium and phosphorus in the intravenous solutions given to very-low-birth-weight infants for two to four weeks after birth. They tested the high-mineral solutions on half of a group of 24 infants weighing less than two pounds at birth. The other half got standard solutions. Bone-mineral content and the rate of increase were significantly higher in the group getting the high-mineral solution. They also retained more calcium and phosphorus, coming closer to levels that occur in the uterus. The results suggest it's possible to reduce the incidence of fragile bones in very-low-birth-weight infants if the infants are fed mineral-fortified milk when they are able to suckle.

*Children's Nutrition Research Center, Houston, TX*

*Richard J. Schanler, (713) 798-7176*

*Laura L. Prestridge, now at the Center for Pediatric Gastroenterology, (214) 640-8000*

**An overenthusiastic enzyme may contribute** to the age-related decline in people's ability to fight infections. A study of laboratory mice shows that the enzyme, cyclooxygenase, is indirectly involved in suppressing T cells. T cells are the immune system's front line defense, but they get sluggish after age 60. The enzyme stimulates production of a hormone-like substance, PGE 2, that suppresses T

cells, so more enzyme means more of the suppressant. That's what researchers found when they compared PGE 2-producing cells from young and old mice. The old cells produced more PGE 2, apparently because of too much enzyme activity. Knowing how the aging body suppresses T cells will help researchers find ways to reverse the trend.

*Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Simin Nikbin Meydani/Michael G. Hayek, (617) 556-3129/3229*

## Crop Production and Protection

**A new soybean variety that withstands diseases, nematodes and insects** has been developed and released by ARS and Mississippi State University. Named Lyon, the new variety resists Race 3 soybean cyst nematodes—tiny worms that plague soybean crops in Arkansas, Louisiana, Mississippi, Missouri and Tennessee by attacking roots and reducing the plant's ability to take in water and nutrients. Lyon also resists stem canker, a lethal fungal disease of soybean stems, and leaf-feeding insects. In three-year variety field trials in Mississippi, Lyon yielded 45 bushels per acre in the presence of stem canker, compared with 21 bushels per acre from a widely grown commercial variety. Foundation seed of Lyon will be available to seed producers this spring.

*Soybean Production Research, Stoneville, MS*

*Edgar E. Hartwig, (601) 686-9311*

**How does an aphid decide which plants to munch on?** Not only by sensing a plant's color, but also its odors. ARS scientists made this discovery as part of a project to study how aphids transmit deadly viruses to plants. In a lab test, researchers cut off pea aphid antennae, attached minute glass electrodes, exposed the antennae to plant odors and analyzed the results on a computer. They found that pea aphids are most sensitive to what are called green leaf odors—the dominant smell of cut grass. They are now determining whether winged aphids are more sensitive to plant odors than wingless ones. Researchers suspect that winged aphids are more sensitive because their primary job is to find a new plant for their offspring to feed on. Wingless aphids concentrate more on feeding and reproduction, rather than moving among plants. The findings, along with behavioral studies, may provide the groundwork for new ways to control aphids.

*U.S. Vegetable Laboratory, Charleston, SC*

*Wilant van Giessen, (803) 556-0840*

**Three genes that fight off costly bean rust disease** can cut from two years to two weeks the length of time it takes to identify their disease resistance. Combining the genes into



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a single bean cultivar also provides a more stable genetic resistance to the disease. The genes help navy, pinto and other types of dry beans resist the rust-causing fungus *Uromyces appendiculatus*, which can lower yields by up to 80 percent. ARS and Michigan State University scientists have discovered markers—pieces of genetic material called DNA—for the three genes. Genetic resistance to rust disease will help reduce the need for chemical fungicides to protect plants. Genetic resistance is becoming more important because the Environmental Protection Agency has banned the use of some chemical fungicides and is expected to restrict others.

*Tropical Agriculture Research Station, Mayaguez,  
Puerto Rico*

*Phillip N. Miklas, (809) 831-3435*

**If crops could sport warmer flowers**, bees and other insects might spend more time pollinating them—resulting in higher yields of fruits or seed grains. That's the implication of findings by ARS scientists who measured temperature differences of up to 12 degrees F among some cocoa flowers. Pollinating bees were more active around warm flowers. A possible explanation is that those flowers may give off more of the natural aromatic chemicals attractive to bees. If the floral heat differs among crop varieties, it may be possible for plant breeders to select for the warmest trait when developing new commercial crop varieties.

*Honey Bee Research Center, Tucson, AZ*

*Eric H. Erickson, (602) 670-6481*

**By measuring cotton leaf temperatures**, it might be possible to identify genetic lines possessing greater heat tolerance. Researchers proved that plants with cooler leaves withstand hotter weather and produce more cotton. This would give breeders a shortcut to breeding superior Pima cotton, a crop valued for its extra long fibers. Until now, locating plants with increased heat tolerance, a major factor in fiber yield, required complicated and expensive tests.

*Maricopa Agricultural Center, Maricopa, AZ*

*Richard G. Percy, (602) 379-4221*

**Farmers can coax an extra 40 bushels per acre of corn** from their irrigated fields by applying two types of nitrogen fertilizer—ammonium and nitrate. Today, most farmers apply only one or the other. ARS scientists discovered, however, that a slightly more expensive half-and-half mix on irrigated corn fields more than paid for itself by increasing yields to more than 220 bushels per acre. Such a combination is known to work on irrigated pastures, but this was the first time researchers showed the yield benefits for irrigated corn. A 50-50 mix capitalized on the key differences in how readily plants use nitrogen from the two sources. While plants directly—and very rapidly—use ammonium, they must first—more slowly—convert the nitrate form to ammonium. That results in a season-long

delivery of nitrogen to plants. ARS scientists confirmed a 50-50 mix, applied without increasing total nitrogen, gives plants a continuous nutrient supply throughout the growing season.

*Soil, Plant and Nutrient Research, Fort Collins, CO*  
*Ronald F. Follett, (303) 490-8220*

**A new ryegrass will give southern ranchers an early-season forage crop**, lengthening the grazing season and increasing weight gains. Grazer ryegrass, released last year by ARS and the University of Georgia, was evaluated over 12 years at 11 locations in Alabama, Florida, Georgia, North Carolina and Texas. Grazer's primary value: It can be overseeded on perennial grasses and begins maturing in April—nearly a month sooner than most commercial annual ryegrasses now on the market. That allows cattle to feed on Grazer in the winter, and then on perennial grasses in the spring. Cattle grazing two bermudagrasses overseeded with Grazer ryegrass gained weight 20 percent faster and produced 50 percent more beef than cattle grazing only the two bermudagrasses. Several companies are interested in commercially producing the seed for farmers.

*Forage and Turf Research, Tifton, GA*

*Wayne W. Hanna, (912) 386-3177*

**Livestock in the tropics may eat peanut plants—minus the commercial edible nuts—as part of their grazing menu.** A two-year field study of 83 wild perennial peanut germplasm introductions singled out four from the Amazon region of South America as the best for cattle, including yield and forage quality. One key advantage of planting perennial peanuts: The top candidates become established quickly. They covered at least 90 percent of test plots in Puerto Rico only 36 weeks after planting—compared to others that can take up to one year to mature. Also, the top four bounced back quickly after 42-days of intensive cattle grazing. Of the wild peanuts, two are *Arachis glabrata* and two are *A. pintoi*. They don't produce harvestable nuts—but they do sprout rich, above-ground vegetation high in proteins and easy for cattle to digest. What's more, the soil benefits because they are legumes that enrich soil by fixing nitrogen. Scientists believe wild perennial peanuts have potential as forage legumes for grazing in the Southeastern United States, Mexico, Central and South America, and Puerto Rico.

*Tropical Agriculture Research Station, Mayaguez,  
Puerto Rico*

*Antonio Sotomayor-Rios, (809) 831-3435*

**Six muskmelon lines from India, Afghanistan, China and Canada** may be a breeder's dream come true for stopping a damaging fungal disease. Those were the most promising of 275 melon germplasm samples from around the world that ARS scientists screened in an ongoing effort to find genetic resistance to *Alternaria* leaf blight. This disease



attacks melon leaves in humid, high-rainfall areas of the Eastern and Midwestern United States, defoliating plants and reducing yields. In greenhouse tests, researchers put the fungus on leaves of each germplasm sample and eight days later measured the plants' resistance. They found that the top six lines are apparently so resistant that they would not require fungicides, compared to susceptible varieties that would be wiped out without those chemicals. After further studies, researchers plan to release the six resistant lines to breeders.

*U.S. Vegetable Laboratory, Charleston, SC*  
*Claude E. Thomas, (803) 556-0840*

**Adult moths of corn earworms, cutworms, armyworms and loopers** can ride the winds as far as 250 miles a night to infest crops over a large area. Scanning radar in Texas' Brazos River Valley in 1988 and 1989 showed insects flying at altitudes up to 2,950 feet during spring, summer and fall. Large numbers of the pests were typically airborne for several hours beginning about 30 minutes after sunset. Some insects flew at altitudes above 2,500 feet where wind speeds were usually greater than 19 miles per hour. Migration-type movement of insects tended to be south to north in the spring and early summer, and north to south in the fall. This information will help scientists develop better methods of wide-area pest control for farmers.

*Crop Insect Pests Management Research, College Station, TX*  
*Kenneth R. Beerwinkle, (409) 260-9351*

**A virus that cuts the commercial value of lilies** can be detected with a new, ARS-developed test that is faster, less costly and more sensitive than current tests. That should help the lily industry, which operates a certification program for producing bulbs free of the pathogen, called lily symptomless virus, or LSV. LSV-infected bulbs usually produce smaller, less valuable lilies. The scientists' new test uses a technique called tissue blot immunoassay. It detected the virus in samples of lily bulbs or plants that other test methods had deemed virus-free. USDA's Economic Research Service has estimated the market value of lilies at \$40 million.

*U.S. National Arboretum, Washington, DC*  
*Hei-ti Hsu, (301) 504-5657*

**A new soybean named Bronson** resists two of the bean's most devastating pests, the soybean cyst nematode (SCN) and a soil-dwelling fungus. Bronson will help Indiana and Illinois soybean growers maintain yields without needing to use nematicides to control SCN. This tiny parasitic worm lives in the soil and attacks soybean roots, severely lowering bean yields. ARS and Purdue University scientists worked together for 10 years to breed the new SCN-resistant variety. In two years of field testing in twelve Midwest and Eastern states, Bronson had slightly higher seed yields—48.5 versus

47.8 bushels per acre(bu/a)—and matured two days earlier than Delsoy 4210, the only other SCN-resistant variety in these tests. On SCN-infested soil, it out-yielded Spencer, the highest yielding non-SCN-resistant variety, by about seven bu/a. Against the soil-dwelling fungus, race 1 of *Phytophthora sojae*, Bronson proved resistant in greenhouse tests. Bronson is the first SCN-resistant variety to be released by the cooperative USDA-Purdue soybean breeding program. Seeds will be made available to seed producers for the 1994 planting season.

*Crop Production and Pathology Research, West Lafayette, IN*  
*Jim Wilcox, (317) 494-8074*

**A new "bait tube" offers longer-lasting boll weevil control** for cotton growers. ARS researchers patented the tubes that attract and kill weevils, using only five to 10 percent of the insecticide typically sprayed on cotton. Originally, coated wooden sticks were placed in cotton fields to lure the weevils. A small plastic chip atop the tubes dispenses a sex attractant. Malathion—cheaper but just as effective as the previously-used insecticide—is coated on the biodegradable, paper-fiber tubes. Plato Industries, Inc. of Houston, TX, markets the technology as BWACT, "Boll Weevil Attract and Control Tubes." Next to come: "ultraviolet absorber" coatings to prolong color and brightness of the tube's yellowish pigment, which is appealing to weevils.

*Boll Weevil Research, Mississippi State, MS*  
*Gerald H. McKibben, (601) 323-2230*

**Chinch bugs are making a comeback** in corn and other grain crops. ARS scientists are screening corn varieties for resistance, running greenhouse tests on scores of corn seedlings throughout the year. Scientists believe that mild winters and increased plantings of grain crops over the past 10 years have boosted the bug's numbers. One of America's worst crop pests a century ago, chinch bugs are rebounding in Kansas, Louisiana, Mississippi, Nebraska and Texas. When the bugs suck the juices from the roots of young corn plants, the latter become stunted or deformed and occasionally die. As ARS tests identify seedlings that withstand such damage, the plants will be field tested. If they again prove resistant, ARS will release them as germplasm to private breeders to develop commercial hybrids for farmers. The greenhouse screening techniques to test resistant corn also will be provided to entomologists who work with the breeders.

*Corn Host Plant Resistance Research, Starkville, MS*  
*W. Paul Williams/Frank M. Davis, (601) 325-2311/323-2230*

**Peanuts from Mexico's highlands** could give a "nuttier" taste to commercial peanut lines that are bred for snack nuts and peanut butter. ARS scientists searched the Mexican



states of Puebla and Guanajuato for unique peanut types—especially the *hirsuta* variety that grows on hairy plants. *Hirsutas* are prized in Mexico for the intensity of their flavor. As a result, these “hairy” peanuts have survived in Mexico despite certain disadvantages when compared to commercial varieties: They mature very late, offer less yield and must be hand-harvested. Some of the 12 *hirsuta* types collected on the trip may turn out to mature earlier than previously known *hirsutas*. Now that the *hirsutas* fill in some of the gaps in the available genetic diversity of peanuts, plant breeders can draw on them to improve commercial peanut lines.

National Germplasm Resources Laboratory,  
Beltsville, MD

David E. Williams, (301) 504-6310

**Hidden genetic flaws in orchids**—such as those that damage flower color—can be identified in a few days instead of the three years now needed. What speeds the process is a “gene gun” that propels a foreign gene into the cells of an orchid. Until now, the gun had been used to introduce new, desirable genes into plants. But this marks its first use to screen plants for breeding purposes. ARS scientists bombarded flower petals from an orchid (*Doritis pulcherrima* Lindl.) with microscopic gold pellets coated with a gene from corn. About 48 hours after the gun is “fired,” the corn gene may turn on in the petal cells—altering the petal’s color for about a day. That happens only if the gene detects the presence of other genes that are likely to produce off-color or other defects in the plant’s descendants, rendering them commercially worthless. Using classical breeding techniques to find the defective genes requires growing plants for three years after crossing them with other plants. Scientists also have successfully tested the gene-gun technique in screening bulb plants and other ornamentals, including petunias and gladiolus.

U.S. National Arboretum, Washington, DC  
Robert Griesbach, (301) 504-6574

**Higher sugar yields have been bred** into three new sugarcane varieties, giving growers a chance to net higher returns. ARS researchers found that the varieties top CP 70-1133—one of Florida’s most popular commercial varieties—either in sugar yield per acre, sucrose content per ton of cane, or millability (how easily cane stalks are processed). Compared with current varieties, growers could expect six percent higher returns from one new variety (CP 85-1308) grown on sand, and ten percent more from CP 85-1382 grown on muck. CP 85-1382 also experiences less sucrose-breakdown when temperatures reach freezing. Another plus: the varieties resist diseases such as eye spot, smut, leaf scald, rust and sugarcane mosaic virus. Scientists in Louisiana and Texas are field-testing the new varieties, originally developed for Florida’s climate and soils by ARS in cooperation with

the University of Florida and Florida Sugarcane League, Inc. Growers can obtain seedcane of the varieties from the company.

Sugarcane Field Station, Canal Point, FL  
Jimmy D. Miller, (407) 924-5227

**A new screening technique helps pinpoint snap, pinto and other bean varieties** for gene-combinations that confer resistance to two of the worst leaf diseases. The diseases—caused by the bean rust fungus and a virus—often reduce crop yields up to 30 percent and can wipe out an entire crop. Currently, no single commercial bean variety resists all races of rust fungus and strains of bean common mosaic virus (BCMV)—including newer strains occurring in Idaho and possibly other bean-growing states. To find resistant lines, ARS researchers inoculated bean plants first with several races of the fungus, followed by certain strains of the virus. They then saved seeds from the plants that stayed healthy to pinpoint the genes conferring resistance. Unlike standard methods, the new technique can rapidly identify plants with a combination of rust-resistance, an “I gene” that protects beans from BCMV, and two other genes that protect against black root. Researchers may develop bean germplasm lines with a combination of the genes for bean breeders and growers.

Molecular Plant Pathology and Biology, Beltsville, MD  
J. Rennie Stavely, (301) 504-6600

Vegetable and Forage Crops Production Research,  
Prosser, WA

Matt J. Silbernagel, (509) 786-3454

**Tomato breeding lines that resist** the voracious Colorado potato beetle have been developed by ARS scientists. Seed from these four lines is available to plant breeders to incorporate into new tomato varieties. The Colorado potato beetle is a significant pest for tomato growers in mid-Atlantic states. Of the new germplasm lines, three also resist *Fusarium* wilt and *Stemphylium solani*; one line resists these two diseases as well as *Verticillium* wilt. These lines have been released after about seven years of research.

Vegetable Lab, Beltsville, MD  
William W. Cantelo, (301) 344-8957

**Part of a gene that plays a role in farm crop maturation** has been cloned by ARS and North Carolina State scientists. It’s the first gene to be linked to the juvenile-to-adult cycle of plants. Without the gene, the maturing process in corn plants was interrupted. Little is known about this “rite of passage” phase in plants, but the new research ultimately could lead to genetically tailored help for crops and other plants as they mature. Discovered in corn and named Glossy-15 by an ARS researcher in the 1930s, the gene was known then to produce wax and leaf hairs on plant leaves. Wax-coated leaves protect the plant during



drought, slowing down moisture loss and repelling water to provide adequate exchange of gases between the air and the leaf surface. Wax can also protect against insects, disease and ultraviolet irradiation damage from the sun. Leaf hairs secrete compounds that can protect plants from pests and disease.

*Plant Science Research Laboratory, Raleigh, NC*  
*Paul H. Sisco, (919) 515-2705*

**A new species of nematode outperforms** another species that growers use as a natural control against the citrus root weevil. In laboratory and greenhouse tests, *Steinernema riobravus* killed 80 percent of weevil larvae, compared to only 60 percent killed by the current nematode species. Orange, grapefruit, lemon and lime growers in Florida lose millions of dollars annually in crop damage by *Diaprepes*. Weevil larvae—the most damaging stage of the pest—feast on citrus roots, interfering with the transport of nutrients and water to the rest of the tree. This results in fewer and smaller fruit, which can cause growers to abandon affected trees. ARS scientists at Weslaco, TX, originally isolated the new nematode species, found in the Rio Grande Valley, and are using it effectively against corn earworm and fall armyworm moths.

*U.S. Horticultural Research Laboratory, Orlando, FL*  
*William J. Schroeder, (407) 897-7379*

## Biological Control

**Sterile male Mediterranean fruit flies** raised to combat medfly outbreaks may have a competitive edge over wild males in attracting mates in the field. That preliminary finding runs counter to current concerns that a lab-reared, sterile male's sex attractant, or pheromone, fizzles, compared to the wild male's and its mating success. But a cooperative study in Guatemala showed that, during the peak mating time between 2 and 5 p.m., sterile males produced more of several key pheromone components than wild flies did. Wild females mated to sterile males lay eggs that fail to hatch, causing a falloff in the medfly population. Now, the new research adds further confirmation that the sterile insect technique—invented by ARS scientists—is effective to control medflies and other fruit flies. It's a strategy that could become even more popular as aerial pesticide spraying is curtailed.

*Insect Attractants, Behavior and Basic Biology Research Lab, Gainesville, FL*  
*Robert R. Heath, (904) 374-5735*

**One-celled protozoa now infect up to 90 percent** of destructive Mormon crickets in parts of Idaho and Montana. Scientists spread the naturally occurring *Vairimorpha* microbes on rangeland in 1991 in efforts to halt the crick-

ets' occasional population explosions. The *Vairimorpha* protozoan only infects Mormon crickets. In some years, hordes of the pests devour all the crop and range plants in their path, inflicting millions of dollars in damage before being stopped by costly insecticides. A team of ARS and other federal and university scientists developed methods to mix the microbe with wheat bran into baits that crickets eat. The protozoan acts slowly, taking up to 12 days to multiply inside young crickets and kill them by consuming their fat. Older crickets take longer to die. Infected females that manage to survive lay fewer eggs—which also become infected.

*Rangeland Insects Lab, Bozeman, MT*  
*Jerome A. Onsager, (406) 994-3344*

**Quarantine specialists at ports of entry**, insect-rearing companies and scientists will no longer have to guess at identifying a group of beneficial wasps. As part of an international cooperative effort, ARS scientists are publishing the first illustrated key that shows over 500 major categories of known adult chalcidoid wasps in North America. Nearly 50 percent of all successes in biological control are attributed to these parasitic chalcidoid wasps. However, the wasps are particularly difficult to identify. Not only are there over 2,500 kinds of Nearctic chalcidoid wasps, but within each kind there are variations, for example, between males and females, winged and wingless, and other exceptional forms. Even exceptional forms, not usually included in keys, are shown in detail.

*Systematic Entomology Laboratory, Washington, DC*  
*Eric Grissell/Mike Schauf, (202) 382-1781/1784*

## Scientific Information Systems

**A user-friendly computer database** for identifying 32 species of the genus *Cucumis* (*Cucurbitaceae*) that includes melons and cucumbers is now ready for use by plant breeders. Species of *Cucumis* are very susceptible to fungal and bacterial diseases, so quick and accurate identification is economically important. Compiled over seven years by an ARS world expert on the genus, the computer catalog includes every known member—over 7,000 samples—of 32 diverse species that also include cassava, honeydew and cantaloupe. Several were earlier incorrectly identified or distributed under older, unknown names. The work, which is the first catalog to be available on computer diskettes, includes the botanical classification and characteristics of the genus and its species as well as pertinent data on its flavonoids, isozymes, DNA and capability for being cross bred. The database can be accessed on MS-DOS computers.

*Systematic Botany and Mycology Laboratory, Beltsville, MD*  
*Joseph Kirkbride, (301) 504-9447*



ARS computer models are yielding clues on how ranchers in various regions can get the most from livestock and rangeland if future environmental changes occur. Among the potential changes: higher temperatures and increased levels of atmospheric carbon dioxide. A CO<sub>2</sub> increase could promote forage growth well beyond today's levels. Computer projections show what ranchers in different states could expect—and so alert them to adapting their practices to new conditions. As an example, Montana ranchers might see a 65 percent increase in forage production and a six percent increase in calves' weight at weaning. But ranchers in Texas might see weaning weights decline, despite a 10 percent increase in forage. That's because higher air temperatures would increase heat stress on cattle.

*Great Plains Systems Research, Ft. Collins, CO  
Jon D. Hanson, (303) 490-8323*

Plants growing at experimental sites throughout California receive water and fertilizer at the command of on-site microcomputers. A central computer, located in a laboratory as far as 600 miles away, monitors this sophisticated network. Scientists at the laboratory conduct experiments on the water and fertilizer needs of tomatoes, grapes, peaches, melons, corn, broccoli, lettuce, cotton and alfalfa. They rely on the lab computer to help manage the network of seven field sites and reduce the need for costly visits each day to these test plots. Hourly feedback from automated soil sensors, weather instruments or other devices at each site allows the system to automatically adjust applications of water and fertilizer. At night, the microcomputers forward the day's readings to the central computer, which then assembles the information for scientists to analyze in the morning. Findings from the experiments help growers maintain or improve yields, conserve water and fertilizer, and reduce chances that nitrates, leached from excess fertilizer, would pollute drinking water. And because the researchers' computerized network is among the most advanced of its kind in the United States, growers interested in similarly automating their farms might adapt ideas from it.

*Water Management Research Laboratory, Fresno, CA  
David A. Clark, (209) 453-3114*

A computer program for fire blight is proving to be successful in alerting growers when this devastating disease will attack pear trees. If growers know when the disease will occur, they can better prepare to fight it. The computer program was developed by ARS and University of Maryland scientists. Called MARYBLYT, the program has nearly 100 percent accuracy in predicting prime conditions for pear blight each year for the past six years. Warm, moist weather is ideal for growth of *E. amylovora*, the bacterium that causes the disease. A grower can run

MARYBLYT on any IBM or compatible personal computer—even most portables.

*Appalachian Fruit Research Laboratory,  
Kearneysville, WV  
Gary W. Lightner, (304) 725-3451*

## Animal Production and Protection

Testing dairy cows for mastitis can be done more efficiently with a modified laboratory device called a flow cytometer. Mastitis, an infection of the udder, costs U.S. dairy farmers \$2 billion annually in treatment and lost milk production. To test for mastitis, dairies must count the number of white blood cells in milk. When a cow's udder becomes infected, white blood cells called neutrophils rush to the infection site to attack the invading bacteria. Normal milk usually has some white blood cells and other cells from the lining of the udder. However, government regulations set a 750,000/ml limit on these somatic cells. Here is where the ARS-modified flow cytometer shines: It can tell the difference between cell types. For example, a flow cytometer can easily detect subclinical mastitis, a condition often missed because cell counts are low and a routine cell count indicates nothing is wrong. But if the cells are mostly neutrophils, an infection is usually present. Subclinical mastitis is insidious because it often causes a practically unnoticeable drop in milk production per cow. If a whole herd becomes infected, milk production can drop five to 10 or even 20 percent—meaning substantial losses for farmers.

*Milk Secretion and Mastitis Lab, Beltsville, MD  
Robert H. Miller/Max J. Paape, (301) 504-8330/504-8302*

Cattle unnecessarily waste as much as one-fourth of the protein in their diets. When cattle consume protein, microorganisms in their rumen often break down some of the protein into ammonia and this nitrogen is lost in the urine. That's wasted feed, costing animal producers up to \$5 billion annually. ARS studies have shown much of the blame lies with three newly discovered rumen microorganisms. One is *Clostridium sticklandii*; the second is closely related to *Peptostreptococcus anaerobius*; and the third is a new bacterial species, *Clostridium aminophilum*. All three of these bacteria can be thwarted by a class of antibiotics called ionophores. These antibiotics have been approved by the Food and Drug Administration as feed additives for beef cattle and dairy heifers, but are not yet approved for use in lactating dairy cows. In laboratory tests, the steady concentration of ammonia in the rumen was cut in half when non-lactating cattle were fed an ionophore called monensin, and numbers of the newly isolated bacteria dropped 10-fold. Researchers are continuing their search for other ways to inhibit the bacteria and reduce protein waste in the rumen.

*U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY  
James B. Russell, (607) 255-4508*



**A legume that flourishes on Australian rangelands** could fill a gap in grazing for beef cattle on Florida pastures. *Stylosanthes giuanensis*—commonly called stylo—matures in October and November, after forages such as hairy indigo and alyceclover have faded and before winter pastures are ready. Stylo offers seven to nine percent more crude protein and 30 to 35 percent more digestible dry matter than mature bahiagrass, a typical tropical grass. Stylo can grow to heights of five feet and produces about three tons of dry matter per acre, comparable to the output of alyceclover and hairy indigo. Stylo persists for several years after planting in south Florida, but will probably require annual reseeding in areas farther north.

*Subtropical Agricultural Research Station,  
Brooksville, FL*

*Mimi J. Williams, (904) 796-3385*

**Lambs are just as sensitive** to the ill effects of aflatoxin in grain as any other livestock. That new ARS finding contradicts conventional wisdom that lambs are relatively resistant to these natural toxins sometimes found in grains. Also, changing the protein source in lambs' diets doesn't help them fend off aflatoxin, even though a change in diets has proven successful in some instances in reducing negative effects of aflatoxin on livestock. These findings came from a study of 32 crossbred lambs. They were fed one of four diets—either soybean meal or fish meal with or without aflatoxin. After five weeks, all the lambs were switched to aflatoxin-free feed for another 32 days. At the end of the study, lambs that had eaten aflatoxin had lower feed intakes, lower daily weight gains, and had to eat more feed to gain weight. Also, they had impaired liver function.

*Food Animal Protection Research Laboratory, College Station, TX*

*Roger B. Harvey/Leon F. Kubena/Thomas S. Edrington,  
(409) 260-9259/9249/9222*

**A fungus that causes honey bee chalkbrood disease** produces a substance that could become a new control for two serious diseases that threaten domestic honey bees. The substance, called linoleic acid, is a common unsaturated fatty acid produced by the chalkbrood fungus, *Ascosphaera apis*. Linoleic acid is commonly found in oils from peanuts, corn, soybeans, cottonseed, sunflower and other vegetables. In laboratory tests, linoleic acid inhibited the growth of two bacteria that cause European and American foulbrood diseases. Currently in the United States, only the antibiotic oxytetracycline is approved by the Food and Drug Administration for controlling those diseases, which could develop resistance to the drug. Both foulbrood diseases, found in all 50 states, infect honey bee larvae inside the colony and can kill the bees if unchecked. American foulbrood is considered the most serious disease threat to domestic honey bees, causing an estimated \$8 million in losses each year.

Nationwide, farmers rent about one million honey bee colonies each year to pollinate about 130 crops valued in the billions.

*Bee Research Laboratory, Beltsville, MD  
Hachiro Shimanuki, (301) 504-8205*

**Pregnant dairy cows need adequate selenium and sulfur** in their diet to produce a healthy calf. While too much selenium can kill the cow, selenium shortages in late pregnancy can cause muscular dystrophy in the calves. To pinpoint proper dosages, researchers tested 18 mature Holstein cows. After 190 to 270 days of pregnancy, they measured the amounts of selenium and sulfur accumulated in the growing fetus. In the third trimester of pregnancy, sulfur accrued at a rate of 1.26 grams per day for the calf fetus and 1.51 grams per day for the entire conceptus—fetus, fetal membrane, fetal fluids and placental tissue. Selenium accretion was 41 micrograms per day for the fetus and 55 micrograms per day for the conceptus. Cows' sulfur and selenium needs during late pregnancy can be calculated by adding these amounts to the normal recommended dietary allowances for a pregnant cow.

*U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY  
William A. House, (607) 255-4502*

## New and Improved Products

**The viscosity of vegetable oil fuels** used as substitutes for diesel can be lowered by adding synthetic compounds called hydroxy fatty acids. Fuel blends made from vegetable oils are typically 10 to 15 times thicker than diesel fuel. This thicker viscosity interferes with fuel injection, causing severe ignition problems in cold weather. Hydroxy fatty acids also appear to work well as additives in other vegetable oil products such as lubricants, soaps and cosmetics. Researchers say some of these acids actually work better than the most commonly used additive, ricinoleic acid, which is derived chiefly from imported castor oil.

*Oil Chemical Research, Peoria, IL  
Gerhard H. Knothe/Marvin O. Bagby, (309) 681-6531*

**A very weak electrical current** on a white plastic pyramid helps control manure-breeding stableflies that migrate from farms to housing developments. Solar power generates the electric current that kills flies but is harmless to birds and other animals. No batteries are needed and the electronic circuit can easily be replaced if required. Made of molded plastic, the pyramid's shape and white base seem to attract flies, but not beneficial insects. A three-foot high model is being marketed by Olson Products, Inc. of Medina, OH, for about \$400. A lower-priced household version may be available soon.

*Livestock Insects Laboratory, Beltsville, MD  
Lawrence G. Pickens, (301) 504-8274*

## Soil, Water and Air

Accurate predictions can now be made of how much sediment will be washed down a stream and deposited on the stream bottom. After three years of operation, an ARS sampling technique is providing valuable sediment data compiled after 10 storms. This information is important to hydraulic engineers and others studying the dynamics of sediment flow and designing controls that make streams less prone to erosion on agricultural watersheds. A Mississippi creek was used as the test site for a four-foot by two-foot by four-foot box installed below the streambed level to continuously record the sediment accumulated during each rainfall. Such sediment flow could previously only be estimated by generally inaccurate sediment-transport formulas.

*USDA National Sedimentation Laboratory, Oxford, MS  
Roger Kuhnle, (601) 232-2971*

Hotophia Creek in northern Mississippi has been given new life. That's due to ARS-developed strategies that cooperating agencies can use to combat streambed erosion. On Hotophia, work begun in 1992 led to restoring fish and wildlife to the stream's newly protected habitat. Stone dikes built along a half-mile stretch doubled the area of deep pool habitat that fish need. Along the banks, a low ridge of stone was laid, and 3,400 willow trees were planted for shade and as a source of woody debris that attracts fish. Fish catches rose—in just one year—from 162 to 746. What's more, the fish were 10 times heavier and almost twice as long. Also, researchers counted twice as many species (24 compared with 12) in the Hotophia—a stream that like others in Mississippi was shallow, badly eroded and sand-filled until restored as part of the federal Demonstration Erosion Control (DEC) Project. This is a congressionally-mandated effort by ARS, the U.S. Army Corps of Engineers and USDA's Soil Conservation Service.

*USDA National Sedimentation Laboratory, Oxford, MS  
Charlie Cooper/Doug Shields/Scott Knight, (601)  
232-2900*

Spreading leaves and grass clippings on poor agricultural lands encourages the growth of earthworms, increasing water infiltration. ARS scientists found that grass and leaf-mulched plots had twice as many earthworms as plots where the previous season's corn stalks were left on the soil. Water infiltrated two to four times faster on the earthworm-laden, residue-covered plots than on those without residue. Soil erosion was not measured on these residue-protected plots, but could be expected to decrease. Plant yields, too, should increase because of the increased organic matter and improved soil structure and fertility. Since earthworms turn organic matter into nitrogen for plants to use, the amount of nitrogen they make available to plants depends on the quality of organic matter. Now scientists are developing

ways to predict the amount of plant-available nutrients in soil from the amount and quality of organic matter left on the surface.

*National Soil Tilth Laboratory, Ames, IA  
Tim Parkin/Ed Berry, (515) 294-6888/9604*

As many as 100 night crawlers per square yard burrow into farm fields left untilled. On these fields ARS scientists found that two inches of water soaked into the soil in just 12 minutes—compared to two hours for tilled fields without worms. As a result of more water stored in the soil, less runs off fields to carry away valuable topsoil and nutrients. Another plus for earthworm-filled fields: The worms' mucus-lined burrows provide plant roots with nitrogen-lined corridors to follow in the soil. Tillage destroys these burrows. Because plant material left after harvest provides food and keeps soil cool and moist, earthworms stay closer to the surface and are more active in no-till fields.

*National Soil Tilth Laboratory, Ames, IA  
Doug Karlen/Ed Berry, (515) 294-3336/9607*

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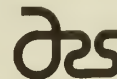


# arterly Report

of Selected Research Projects January 1 to March 31, 1994

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

### Cooperative Research and Development Agreements

...With Demeter Biotechnologies, Ltd., of Research Triangle Park, NC, to genetically engineer potatoes and tomatoes with increased resistance to post-harvest diseases. These diseases cause over \$400 million in commodity losses each year. Demeter is supplying its lab-designed genes for antibacterial proteins, known as lytic peptides, to produce potatoes and tomatoes more resistant to bacterial soft rot, ring rot and blackleg. ARS scientists are providing a gene fragment called a promoter to serve as an on-off switch for the peptide genes. ARS and Demeter will also study ways to use molecular genetics to improve the nutritional value of potatoes by increasing production of the amino acids lysine, tryptophan and methionine.

ARS Contact: William Belknap, Process Biotechnology Research, Albany, CA, (510) 559-6072

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

The report is now available in several electronic formats.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact Ann Whitehead, National Patent Program, Bldg. 005, Rm. 401, BARC-West, Beltsville, MD 20705, (301) 504-6786. Questions about a particular company's product and/or research should be directed to the company itself.

...With W.R. Grace & Co.-Conn. of Columbia, MD, to improve formulations of the beneficial soil fungus *Gliocladium virens*. The fungus-discovered and identified by ARS scientists-controls "damping-off" diseases of seeds or seedlings of petunias, chrysanthemums, tomatoes, cucumbers and other crop plants. Two soil-borne plant pathogens, *Rhizoctonia solani* and *Pythium ultimum*, cause the damping-off diseases. The diseases cost growers up to \$300 million annually in an \$8 billion bedding-crop industry. ARS scientists invented technology for formulating the *Gliocladium* fungus into easy-to-apply pellets. They're also exploring ways of combining the pellets with fertilizer, and developing water-dispersed formulations to protect potted ornamentals such as poinsettias and chrysanthemums. The Environmental Protection Agency approved commercial use of the pelletized fungus. (PATENT APPLICATIONS 04/668,512 and 04/724,147)

ARS Contact: Robert D. Lumsden, Biocontrol of Plant Diseases Laboratory, Beltsville, MD, (301) 504-5682

...With Franz Haas Machinery of Richmond, VA, to develop biodegradable, water-resistant coatings for starch-based foam cups and other single-use items. Haas Machinery has developed a new way to make items from 100 percent potato starch or cornstarch. Cups, plates and packaging made from 100 percent starch-based foam could break down into compost or be used as animal feed. But the starch absorbs water quickly and becomes too soft for a usable product. ARS scientists are evaluating several natural, biodegradable polymers for use as water-resistant coatings.

ARS Contact: Randal L. Shogren, Plant Polymer Research, Peoria, IL, (309) 681-6354

...With Starkey Farms of Galena, MD, to grow fresh market tomatoes using hairy vetch instead of the usual non-degradable plastic mulches applied in vegetable production. Hairy vetch as mulch is a low-input, no tillage, sustainable agricultural system that eliminates soil erosion, provides organic matter to improve soil fertility and recycles nutrients from lower depths of the soil to the surface. Also, vetch is a legume capable of transforming atmospheric nitrogen into a form that plants can use as natural fertilizer. Developed by ARS scientists, this system reduces production costs by \$800 per acre by cutting down on plastic mulches, tillage, fertilizer and herbicides. Using vetch mulches improves soil fertility and fruit quality and increases tomato yields up to 40 percent.

ARS Contact: Aref Abdul-Baki, Vegetable Laboratory, Beltsville, MD, (301) 504-5057



...With Biotechnology Research and Development Corp. of Peoria, IL, to develop and commercialize a natural-product coating for fruit that will fend off and induce resistance to rot-producing fungi. A yeast and a natural fungicide in the coating helps increase shelf life and reduce post-harvest decay. This could offer an alternative to synthetic chemical fungicides now used to control post-harvest diseases of fruits. Many fungicides have been withdrawn from the market because of food safety concerns, leaving growers with few weapons to fight these diseases that destroy about 25 percent of their crop.

ARS Contact: Charles L. Wilson, Appalachian Fruit Research Station, Kearneysville, WV, (304) 725-3451

## Patent Licenses

...To EcoScience Corp. of Worcester, MA, for a bacterial spray mixture that protects apples, pears and citrus from post-harvest rots. Based on a bacterium discovered by an ARS scientist, the mixture Bio-Save 11 is an alternative to chemical fungicide treatments. The bacterium in Bio-Save 11 is found naturally on the surface of apples. Farmers worldwide spend about \$75 million annually on treatments to combat post-harvest diseases of fruits and vegetables. EcoScience expects product approval from the Environmental Protection Agency within two years. (PATENT APPLICATION 07/618,437)

ARS Contact: Wojciech Janisiewicz, Appalachian Fruit Research Station, Kearneysville, WV, (304) 725-3451

...To VACSYN, Inc. of Tampa, FL, to develop and commercialize a vaccine for cattle "shipping fever." A bacterial organism, *Pasteurella haemolytica*, spreads among cattle during long-distance shipping to feedlots, causing the disease that costs U.S. cattle producers an estimated \$1 billion annually. An experimental vaccine was developed and patented by ARS and VACSYN. In field trials, the vaccine prevented bacterial infection in the lungs of 30 calves exposed to *P. haemolytica*. Unvaccinated animals had severe lesions and high numbers of the bacterial organism in the lungs. (PATENT APPLICATION 08/075,064)

ARS Contact: Kim A. Brogden, National Animal Disease Center, Ames, IA, (515) 239-8593

## New and Improved Products

**Suncrisp, a new chipping potato**, can be used directly from the field to make chips, as well as from storage. A late-maturing variety, Suncrisp is much less susceptible to heat necrosis (which causes brown splotches on chips) than Atlantic, the No. 1 chipping variety. ARS studies showed that the color of chips from Suncrisp processed directly from the field is as good as that of chips from Atlantic. Also,

chips made from Suncrisp potatoes that have been in cold storage two to three months have slightly better color than chips from Atlantic. Resistant to race A of the golden nematode and potato virus Y, Suncrisp also shows some resistance to late blight. Scientists at the Florida, Pennsylvania and New Jersey Agricultural Experiment Stations participated in research and evaluation of this new potato. Seed is available from seed growers.

Vegetable Laboratory, Beltsville, MD  
Kathleen G. Haynes, (301) 504-7405

**A yeast discovered on lemons** can be added to citrus coatings to fight mold and lengthen the fruit's shelf life up to two months. ARS scientists applied the yeast, *Candida guilliermondii*, to grapefruit that had been heat-treated against fruit flies. Results: The yeast devours nutrients from the fruit's surface that otherwise would feed green mold that can destroy the fruit. Packinghouses already coat citrus to prevent moisture loss during shipment and storage, so this could be an ideal time to add the yeast. Patents have been awarded to ARS scientists for both the yeast and the fruit coating. (PATENT APPLICATIONS 07/745,796 and 07/679,849)

Subtropical Horticulture Research Station, Miami, FL  
Raymond G. McGuire, (305) 238-9321

**Juice drinks and other beverages** may offer the cloudy look of fresh-squeezed orange juice—without adding fats or oils. ARS researchers have identified two natural ingredients that contain no fats or oils, unlike some clouding agents now on the market. The compounds, citrus pectin and purified soy protein, won't alter flavor when added at a rate of about a teaspoon per gallon of beverage. In contrast to pulp, which settles at the bottom of a glass or carton, the pectin-soy cloud remains suspended. A group of major U.S. citrus and soft drink companies, the Citrus Products Technical Committee, funded part of the research. (PATENT 5,286,511)

Fruit and Vegetable Chemistry Laboratory,  
Pasadena, CA  
Jerome Klavons/Raymond Bennett/Sadie Vannier,  
(818) 796-0239

**Sugar lactose is broken down** in cow's milk by a bacterium that ARS scientists altered. They've received a patent on this lower-cost way of making lactose-free dairy products. Some 70 percent of the American adult population can't digest lactose in milk. ARS scientists developed an altered form of the bacterium *Streptococcus thermophilus*, used to make cheese and yogurt. That bacterium produces an enzyme to break down the lactose. Because it has food-grade status and is more heat-stable than similar enzymes from other sources, the altered bacterium can be added directly to milk before pasteurization. Also, it can be stored for long periods of time without losing enzyme activity. Use



of the enzyme-producing bacterium could replace costlier methods that extract enzymes from yeasts or fungi now used to reduce lactose in milk. (PATENT 5,198,351)

*Milk Components Research, Philadelphia, PA*  
*George A. Somkuti, (215) 233-6474*

**A new low-fat, low-salt mozzarella cheese** developed by ARS scientists has melting qualities of full-fat mozzarella. The cheese has less than 10 percent fat, compared with 17 percent in part-skim mozzarella and 23 percent in full-fat mozzarella. Normally, when Italian cheeses like mozzarella are made, the dense cheese curd is cooked at about 110 degrees F. But, scientists lowered cooking temperatures to 94 degrees F. This enhances the normal breakdown of milk proteins in the curd, resulting in a lower-fat cheese that melts well and provides the same eating consistency as full-fat cheese. At least four companies have expressed interest in commercializing the ARS research. The cheese addresses the needs of health-conscious consumers who enjoy pizza. (PATENT APPLICATION 08/109,570)

*Milk Components Utilization Research, Philadelphia, PA*  
*Edyth L. Malin, (215) 233-6444*

**A biodegradable stain remover** using agricultural commodities as key ingredients to remove oil from fabric is being patented by ARS scientists. The stain remover is a mixture of ethanol, water and non-petroleum based chemicals. Most commercial methods to remove oil stains use petroleum-based chemicals. In tests, researchers treated fabric stained with a combination of soybean and motor oils. After three to five minutes, the fabric was rinsed with water, dried and found to be equal in appearance to the unstained area. Other tests proved the composition effective against grease and common household stains—such as lipstick, mascara, ketchup, mustard and ink. The ARS stain remover is non-flammable and stable at room temperatures. (PATENT APPLICATION 08/075,250)

*Plant Science Research, Philadelphia, PA*  
*Remon Joubbran/Nicholas Parris, (215) 233-6453*

**Wheat plants of tomorrow** may be genetically tailored more quickly and easily so they yield more nutritious flour or more effectively fend off insects or disease. In lab experiments, ARS scientists found shortcuts for shuttling new genes into wheat embryos. Typically, wheat has been among the most difficult of the grain crops to genetically engineer. But researchers can now produce hundreds of fertile, healthy, bioengineered plants in about six months. Scientists used a gene gun to fire lab-built genes into young Bobwhite wheat embryos. The next step: apply the technique to wheat types grown commercially in the United States.

*Crop Improvement and Utilization Research, Albany, CA*  
*Troy Weeks/Olin Anderson/Ann Blechl, (510) 559-5773*

**A patent has been granted on a new edible coating** that retards ripening and browning of fresh fruits and vegetables. ARS scientists developed the new water-based coating, which contains natural food ingredients necessary to slow ripening. Fresh fruit and vegetables can suffer 25 percent spoilage loss from the farm gate to retail outlets. The new coatings use a combination of ingredients that can be tailored for specific vegetables, fruits or fungi such as mushrooms. The coatings partially retard shriveling and reduce gas exchange and browning reactions. When combined, these two effects slow deterioration of the product, thus preserving flavor. In some cases, flavor is actually enhanced. Two companies, Sealed Sweet Growers Inc. of Vero Beach, FL, and J.R. Brooks & Son Inc. of Homestead, FL, hold licenses on the technology. It has also been sublicensed to EcoScience Inc. of Worcester, MA, for commercial development. (PATENT 5,198,254)

*Citrus and Subtropical Products Research Lab,*  
*Winter Haven, FL*  
*Elizabeth Baldwin, (813) 293-4133*

## Animal Production and Protection

**A little known drug, paromomycin,** has been found to be the first highly effective and non-toxic drug against a major cause of diarrhea in dairy and beef calves. USDA and the Walter Reed Army Institute of Research, Washington, DC, have applied for a patent to use the drug against the intestinal parasite cryptosporidium in animals. Calves treated daily with 100 milligrams of paromomycin per kilogram of body weight were 100 percent protected when challenged with cryptosporidial organisms. Virtually all similarly treated mice were also completely protected from infection. Cryptosporidiosis is one of the top three diseases in calves up to four weeks old. There is no approved treatment for the parasite which is spread via the animals' feces. Paromomycin has already been cleared by the Food and Drug Administration for use in humans, including pregnant women, who are infected with two other serious intestinal parasites—giardia and intestinal amoebae. In developing countries, cryptosporidiosis is a widespread and serious health problem. Individuals who have immune deficiencies are especially at risk. In the United States, it is a growing problem in day care centers for both children and adults. In 1993, 406,000 people in Milwaukee, WI, became infected via contaminated drinking water. (PATENT APPLICATION 08/050,582)

*Zoonotic Diseases Lab, Beltsville, MD*  
*Ronald Fayer, (301) 504-8201*

**Proteins that bind and store copper and zinc** in the body can be measured more accurately and faster by a newly developed technique—adapted by ARS scientists in collaboration with Scottish scientists. Also, nutritionists and other



scientists can use the technique to assess levels of copper and zinc—essential for good health—in people and animals. ARS scientists adapted a new molecular separation technique to measure proteins called metallothioneins (MT). These proteins bind otherwise toxic copper and zinc in forms that will not harm the body's cells until they are needed. That technique, called micellar electrokinetic capillary chromatography, was used successfully to isolate three distinct MT forms from rabbit liver and all four of the known MT forms from sheep liver. The process is 12 to 100 times faster than previous techniques and uses 1,000 times less tissue. Ten thousand volts of electricity were discharged into extracts from liver or kidney to obtain the protein levels.

*Nonruminant Animal Nutrition Lab, Beltsville, MD*

*Mark P. Richards, (301) 504-8892*

*Rowrett Research Institute, Aberdeen, Scotland*

*John H. Beattie*

**Aflatoxin, a natural toxin that fungi produce in grain,** could be a culprit in animals' vitamin E deficiencies. ARS researchers found that vitamin E injected into pigs had no effect on aflatoxin, but the aflatoxin did reduce body storage of the vitamin. In studies searching for a way to counteract aflatoxin in swine that had eaten tainted feed, the animals received vitamin E injections. Body weights were lower for swine that got aflatoxin or aflatoxin plus vitamin E.

*Food Animal Protection Research, College Station, TX*

*Roger B. Harvey/Leon F. Kubena, (409) 260-9259*

**A diagnostic test for whipworm** detects infection early from this serious parasitic disease of pigs. ARS scientists used a worm antigen to detect antibodies to whipworms in pigs' blood. Symptoms of whipworm infection—diarrhea, severe anemia and growth retardation—resemble those of other intestinal maladies common to young pigs, so an accurate test was needed. Whipworm infections can cost a farmer up to \$13 per pig in treatment and lost weight gain. Some farmers have reported losses in excess of \$10,000 for an outbreak. Most intestinal parasites can be detected by the presence of their eggs in the animal's feces. But illness in whipworm-infected pigs is caused by young worms that don't yet produce eggs. Furthermore, adult female whipworms produce eggs sporadically. Early detection and treatment of whipworm infections will lead to faster weight gain and fewer deaths of young pigs.

*Biosystematics Parasitology Lab, Beltsville, MD*

*Dolores E. Hill, (301) 504-6443*

**Sheep may be given genetic resistance** to a virus that outsmarts vaccines designed to control it. Known as the visna virus, it causes pneumonia, encephalitis and arthritis in sheep. It is transmitted at birth, nursing or contact with saliva. Often undetected, the visna virus costs farmers

money for feed and medicine even though they may not know what ails their animals. In some areas of the country, as many as 50 percent of the sheep are infected. ARS scientists decided to build resistance to visna virus into the genes of sheep. They inserted into fertilized sheep eggs the genes that code for a protein in the virus's outer coat. The coat protein stimulates antibody production. It also plays an important role in viral infection by attaching the virus to host cells. Then they placed the eggs in surrogate mothers. So far, three ewe lambs have been born with the antibody-stimulating protein. When there are enough offspring that carry the gene, the scientists will attempt to infect them to test whether the inserted gene can completely protect sheep from the visna virus by filling the attachment sites of the host's cells that would otherwise be filled by the virus.

*Gene Evaluation and Mapping Lab, Beltsville, MD*

*Caird E. Rexroad, (301) 504-8342*

**Poultry producers count on medicated feed** to keep broilers healthy from hatching to processing. Mills mixing poultry feed need ways to check that medications are kept out of subsequent batches of other feeds. In the past, tests to check for the presence of the drugs, called coccidiostats, could take days. New tests developed by ARS researchers give results in a few hours. The tests rely on monoclonal antibody probes—the same technology used in home pregnancy tests. ARS has a cooperative research and development agreement with Neogen Corp. of Lansing, MI, to develop a commercial test kit that also could be used in poultry processing plants to check for drug residues in birds' bodies.

*Food Animal Protection Research, College Station, TX*

*Larry H. Stanker, (409) 260-9306*

**When it's dark, a fire ant foraging for food** finds its way back home by using an "internal compass" that senses the earth's magnetic field—the first time this phenomenon has been found in ants. As a result, ARS researchers are investigating the possible relationship between the ants' magnetic sense and their attraction to electrical current. It may be possible to attract fire ants—now infesting southern states—to a toxic bait using a magnetic or electrical field. A compass-like material, called magnetite, apparently allows the fire ants to sense the normal south-to-north direction of the earth's magnetic field. When researchers altered the normal magnetic field in total darkness, it took the ants about 30 minutes to form a trail to a food source—about twice as long as under normal conditions. Also, the fire ant may use its magnetic sense for orientation inside the dark confines of its nest. Chemicals are used to control the imported fire ant, *Solenopsis invicta*, which entered the United States from its native South America aboard cargo ships in the 1930s. Its stings are painful, and many people develop hypersensitivity to the ant's venom. Pest control



companies consider the fire ant to be a serious household pest in the Southeast. While chemicals effectively control fire ants, the chemicals are not specific and can harm other organisms.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL  
Robert K. Vander Meer, (904) 374-5918*

**Saliva from flea bites** has been known to cause human allergies, but a new study was the first to determine that flea debris can also be the cause. ARS and University of South Florida scientists discovered that the proteins, called allergens, in flea feces, egg shells, shed skins and other debris can cause allergies. These allergens trigger an allergic person's immune system to overreact, causing watery eyes, itching and other symptoms. The culprit allergens were identified in debris of the cat flea (*Ctenocephalides felis felis*), which feeds on dogs and cats. Samples of household dust in the Tampa, FL, area revealed live fleas and debris in it. Six of 48 people who were predisposed to allergies reacted to the flea debris allergens. Researchers say allergy-sensitive people should prevent fleas, including those on pets, and other allergy-causing insects from infesting their homes.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL  
Richard J. Brenner, (904) 374-5937*

**Dosing newly hatched chicks** with harmless bacteria may lead to poultry free of the two major food-poisoning organisms—campylobacter and salmonella. ARS laboratory studies found the number of campylobacter and salmonella bacteria in chicks' intestines was reduced up to 100 fold or more. First, an aerosol spray of the harmless bacteria is applied as the chicks are hatching. A second treatment is added to their first drinking water. The bacteria come from the intestines of adult chickens and are prepared in the absence of oxygen. Growth of the culture in the absence of oxygen encourages proliferation of these protective bacteria. These bacteria are used to colonize the chick's intestines and crowd out or compete with the disease-causing foodborne organisms. (PATENT APPLICATION 08/031,938)

*Poultry Microbiological Safety Laboratory, Athens, GA  
Norman J. Stern, (706) 546-3516*

**Deer ticks use smell** to locate sites where they can "ambush" their hosts—a finding that leads to a better understanding of how ticks improve their chances of finding their next meal. Deer ticks spread lyme disease, which causes arthritis and heart and neural problems in humans and dogs. ARS researchers found that the ticks recognize substances associated with glands on the legs of white-tailed deer. Also, the ticks respond similarly to does' urine. When the

secretions or urine were rubbed on sections of glass tubing, the ticks congregated on those areas. This reaction can explain why ticks gather on vegetation along deer trails. Researchers are now working to isolate the chemical stimulus in the secretions and urine. This may lead to traps for controlling ticks and for use in surveying the number of ticks in specific areas.

*Livestock Insect Laboratory, Beltsville, MD  
John F. Carroll/Edward T. Schmidtman,  
(301) 504-9017/8973  
Insect Chemical Ecology Laboratory, Beltsville, MD  
Jerome A. Klun, (301) 504-9388*

**You don't want to breed cockroaches** in your home, but scientists want to raise them for laboratory experiments. Not just a handful, but enough for repeated tests month after month. Mass-producing large numbers has been difficult. Now researchers have found a way to raise thousands of them—and it takes only five hours of lab work a week. They stock about 400 female roaches and their eggs in rearing containers. These eggs later emerge into roughly 16,000 immature adults called nymphs. After about seven weeks, about one-quarter of the nymphs develop into adults. The result is a container of 4,000 adult cockroaches—a scary sight for an apartment dweller but a welcome one for researchers working on insecticides and other ways to suppress roaches.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL  
Richard S. Patterson, (904) 374-5910*

## Human Nutrition

**People with elevated cholesterol** will get the most benefit from a reduced-fat diet by cutting out as much saturated fat and cholesterol as possible, according to a six-month study. Researchers wanted to clarify inconsistent findings on dietary cholesterol's impact on blood cholesterol that might be due to an interaction with different types of fat in the diet. So they tested four variations of a 30-percent-fat diet on 14 men and women with moderately elevated LDL cholesterol—the artery-damaging kind. Two-thirds of the fat in the diets was either corn oil or beef tallow. Beef tallow is rich in stearic acid, which reportedly has no effect on blood cholesterol, but tallow has equal amounts of another saturated fatty acid known to raise cholesterol. Both diets were tested with and without one added egg yolk per day to raise the cholesterol content. The volunteers did better on the corn oil diet, even with the extra cholesterol. LDL cholesterol dropped 17 percent below baseline levels without the added egg yolk, 12 percent with it. On the beef tallow diets, LDL cholesterol dropped eight percent without the

added egg yolk and stayed about the same with it. Since beef tallow also contributes some cholesterol, the added egg yolk pushed cholesterol content to twice the recommended limit.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Alice H. Lichtenstein, (617) 556-3127*

**Undereating can depress people's infection-fighting capability** when they are also under extreme overexertion—even for young, physically fit bodies. That's what happened to men in the rigorous U.S. Army Ranger training program and to others competing for the Special Forces. One group of Ranger trainees consumed only 70 percent of the calories they burned daily and had a 50 percent drop in one test of immune response during the eight-week course. A second group was given more calories—80 percent of what they burned daily—and that put less of a strain on the immune response. It fell an average 30 percent. A third group of Special Forces aspirants replaced 94 percent of the calories they burned daily, and their immune function dropped about 20 percent. By contrast, a fourth group of women inductees had a dramatic improvement in immune response during eight weeks of basic training. It increased 150 to 200 percent because they got more than enough calories to replace what they burned and their exercise program was moderate. In fact, the training improved the fitness of the women who were a little "out of shape."

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*Tim R. Kramer, (301) 504-8459*

**High blood levels of Lp(a)**—a tiny sphere of lipid similar to artery-clogging LDL cholesterol—further increases risk of heart disease in people who have elevated cholesterol. In a 10-year coronary prevention trial, Lp(a) levels were 21 percent higher in men who subsequently developed heart disease than in those who did not. The trial enlisted men with total cholesterol above 265 milligrams per deciliter and LDL cholesterol above 190 mg/dL. Current guidelines call for total cholesterol to be below 200 mg/dL, LDL cholesterol below 170. Researchers measured Lp(a) levels in blood taken from 623 of the subjects at the beginning of the trial and compared levels in those whose coronary arteries became blocked during the 10 years with those who stayed free of heart disease. The 21-percent difference in Lp(a) between the two groups remained significant, even after researchers accounted for the men's age, body fat levels, smoking habits and blood levels of LDL and HDL cholesterol. Lp(a) appears to be an independent risk factor for heart disease—at least in men with a poor cholesterol profile.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Ernst J. Schaefer, (617) 556-3100*

## Crop Production and Protection

**Soymilk and tofu could have a new, milder flavor** from soybean varieties that ARS scientists are now developing. An edible soybean that's more palatable could widen overseas markets for American farmers and also lead to development of new domestic markets. ARS scientists already have bred out the rancid taste in new soybean varieties. These new varieties have acceptable yields, are tolerant to insect attack and resist pod shattering. However, tofu and soymilk made from these beans are more yellow, compared to traditional beans. Yellowing can be mistaken as a sign of spoilage in soyfoods. ARS scientists are now working on identifying and removing the chemical responsible for the yellow color. Growing techniques are the same for edible soybeans as for the beans used for oil and animal feed.

*Crop Production and Pathology Research,  
West Lafayette, IN*

*Niels Nielsen, (317) 494-6076*

**A natural fungal pathogen** could give potatoes a new defense against the root lesion nematode, the costliest plant-parasitic nematode in the northeastern states. Root lesion nematodes can reduce potato yields by 45 percent. Most chemical pesticides traditionally used against these nematodes have been withdrawn from the market because of environmental and human health concerns. The result: a resurgence in potato production problems linked to the nematodes. In growth chamber tests, applications of the fungus *Hirsutella rhossiliensis* on potato roots reduced by 25 percent the number of nematodes entering the roots. Subsequent population buildup of those that did enter was reduced 20 percent. Further studies will focus on ways to increase the effectiveness of *H. rhossiliensis* as a biological control agent.

*Plant Protection Research, Ithaca, NY*

*Bill B. Brodie/Patricia Timper, (607) 255-2459*

**Mexican bean beetles fare poorly** when they try to feed on a new breeding line of high-yielding semidwarf soybeans. Naturally occurring chemicals in the plants slowed the growth of beetle larvae so they died on the leaves in greenhouse tests. That compared with 76 to 84 percent that survived on popular semidwarf varieties. Added to this pest resistance is a high yield that will help plant breeders develop soybean varieties that make the per-bushel cost of growing resistant soybeans cheaper than growing varieties that must be sprayed. At one test site, the new line produced nearly 80 bushels per acre. Called HC83-193, the new resistant line that ARS and Ohio Agricultural Research and Development Center scientists



developed has averaged about eight bushels more per acre than yields from earlier beetle-resistant germplasm. HC83-193 is best suited for developing insect-resistant varieties for the Midwest.

*Corn and Soybean Research, Wooster, OH*  
Richard L. Cooper, (216) 263-3875

**Corn breeding lines can borrow genes** from mutant cousins to increase the nutrition in grain—cereal for people and feed for farm animals. Typical corn seeds don't carry enough lysine, methionine, calcium, iron and zinc to meet the dietary needs of people, poultry and swine. But mutant corn lines containing the opaque-2 gene have higher lysine and methionine. Other mutant lines have a Mal (multiple aleurone layer) gene; most of the minerals in corn are found in its row of aleurone cells. ARS tests found that corn bred to incorporate the opaque-2 gene had higher levels of lysine and methionine, plus calcium, magnesium, iron, zinc and manganese. Incorporating the Mal gene increased concentrations of several essential minerals, including iron, zinc, manganese, copper and calcium.

*U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY*  
Ross M. Welch, (607) 255-5434

**Potomac, a new pear variety**, resists fire blight—the oldest, most serious disease of pomaceous fruit trees. A bacterium causes fire blight, which attacks all parts of a tree. ARS scientists have released the variety to plant breeders, and it should be on the market in about two years for use in home orchards. Potomac has excellent flavor and texture and can be used by commercial growers who plan to store the fruit for less than two months. A light-green, glossy skin covers moderately fine and buttery fruit that has very little grit. Cooperating scientists evaluated the variety in Arkansas, Maryland, New York, Ohio, Oregon and West Virginia.

*Appalachian Fruit Research Laboratory,*  
*Kearneysville, WV*  
Richard L. Bell, (304) 725-3451

**A gene has been found in tomatoes** that regulates the type of sugar accumulated. This means that genetic techniques may be used to alter the type of sugar stored and possibly raise or lower the sugar levels critical for tomato flavor and processing quality. ARS scientists have named the gene *sucr*. Tomato flavor comes from a balance of sugar and acid levels. That part of a tomato used for processing directly depends on its solids content. Sugar makes up about 50 percent of tomato solids. That percentage might be genetically altered, using the new gene, to satisfy changing customer and industry trends in the fresh and processing markets.

*Vegetable Laboratory, Beltsville, MD*  
John R. Stommel, (301) 504-5583

**An unusual type of mountain ash tree** may yield delicious fruit, making it an attractive candidate for home landscaping. Familiar mountain ash trees bear small, colorful, yet inedible berries in the fall. But a lesser-known tree that dates back to the 1600s—a natural hybrid of mountain ash and pear—bears fruit that's about the size of an apricot and has the sweet, mild taste of a pear. An ARS gene bank preserved the uncommon hybrid, called *Sorbopyrus* (for *Sorbus*—mountain ash, and *Pyrus*—pear). ARS supplies cuttings of the hybrid to breeders, nurseries and amateur fruit growers, including an Oregon nursery that now sells several hundred young *Sorbopyrus* trees a year. *Sorbopyrus* is one of more than 60 different kinds of mountain ash from around the world that ARS safeguards at the gene bank.

*National Clonal Germplasm Repository, Corvallis, OR*  
Kim E. Hummer, (503) 750-8712

## Soil, Water and Air

**Healthy, fertile soil puts out an earthy odor** that ARS scientists are analyzing so they can give farmers a "measuring stick" of how rich—or poor—the soil is. Some day, a meter that farmers can use may be the answer, based on compounds produced by soil microorganisms as they break down dead plants and organic matter. It's these compounds that form the earthy odor. Scientists are developing ways to measure two of the compounds, geosmin and 2-methylisoborneol. They are produced by soil fungi and filamentous bacteria called actinomycetes. In preliminary tests, more than 20 times as much geosmin and methylisoborneol were measured in virgin woodland soil than in cropland soil. That indicates the presence of beneficial fungi and actinomycetes in the virgin soil. Scientists will carry out further tests to establish the role of these compounds as indicators of microbial activity. If verified, the soil readings of these compounds and perhaps others could be taken by a meter for on-the-scene analysis of soil health.

*National Soil Tilth Laboratory, Ames/Ankeny, IA*  
Peter Stahl/Timothy Parkin, (515) 294-9762/6888

**Legumes used as winter cover crops** conserve moisture and boost yields for the next crop. A three-year study by ARS and the University of Maryland shows that corn planted in killed legumes had 10 to 15 percent higher yields, compared to corn planted in wheat stubble or bare ground. Moisture was conserved by the remnant legume stems and leaves trapping rainwater and reducing soil water evaporation. Also, the legumes used less water than wheat when they were growing during the winter. Legumes allow farmers to cut nitrogen fertilizer use by 20 to 60 pounds an acre, too. Hairy vetch supplied the most nitrogen.

*Environmental Chemistry Lab, Beltsville, MD*  
John J. Meisinger, (301) 504-5276

Conservation tillage that only slightly disturbs the soil will build up soil carbon that boosts plant production. That was the key finding in a 12-year study, the first to measure carbon in the sandy soils of the Southeastern Coastal Plains. Corn, cotton, soybeans and wheat were rotated in two different systems--conservation tillage and traditional tillage in which soil is disked or plowed. ARS scientists found that after 12 years, carbon in the top six inches of soil on conservation-tilled fields nearly doubled, while carbon did not increase on the other plots. Conservation tillage assures that bacteria on the soil surface slowly break down plant residue so it's available for crops.

*Coastal Plain Soil, Water and Plant Conservation  
Research, Florence, SC  
Patrick G. Hunt, (803) 669-5203*

A medical instrument is providing quick clues as to how well crops may grow in a particular soil. ARS scientists developed a way to use a microplate reader--standard equipment for checking blood samples in medical laboratories. Now, the reader can do enzyme tests of as many as 40 soil samples in three seconds. Standard soil testing methods take five to seven days. As used by farm consultants or soil test services, the microplate reader tells the user the relationship of the soil to its organic matter content. Another benefit: Smaller amounts of soil used in the microplate reader mean smaller amounts of chemical reagents are used, so there's less chemical waste.

*Soil and Water Research, Columbia, MO  
Robert J. Kremer, (314) 882-6408*

Wind tunnel tests show crop stalks left standing after harvest protect soil from wind erosion seven times better than stalks lying flat on the ground. Tests at wind speeds up to 40 mph enabled ARS scientists to develop a new mathematical equation to predict the erosion protection offered by standing stalks, flat stalks and a combination of both. The tests also led to improved prediction of erosion protection offered by a greater range of soil covers. The equations will be used in a new USDA national wind erosion model to recommend farm practices that will control wind erosion.

*Cropping Systems Research Laboratory, Big Spring, TX  
J.D. Bilbro, (915) 263-0293*

Restoring stream habitat isn't the only new technology used in the federal Demonstration Erosion Control (DEC) Project, a congressionally-mandated effort by ARS, the U.S. Army Corps of Engineers and USDA's Soil Conservation Service. ARS scientists spent several weeks videotaping aerial views of 1,100 miles of restored channels from Memphis, TN, to Vicksburg, MS. Data developed from the tapes, allows scientists to monitor the performance of dikes and other stream-protection measures they designed for installation by the Corps and SCS. The data also helps

them track land-use changes, and complements LANDSAT satellite imagery used for broad land classification. Manually collecting the same data would have taken thousands of hours.

*USDA National Sedimentation Laboratory, Oxford, MS  
Bill Blackmarr/Joe Murphey, (601) 232-2928/2922*

## Biological Control

America's food processing industry is giving a helping hand to ARS scientists so they can mass-rear a wasp species that's a promising biocontrol against destructive boll weevils. It's tough to raise enough of the wasps for tests in cotton fields. Up to 1,000 females of the *Catolaccus grandis* species are needed for release each week during cotton's fruiting period. ARS researchers modified food processing and packaging technology to mass-produce the wasps, using a steady supply of young weevils as food. That meant using: a "flash sterilizer" to cook a diet of nutrients, special rearing containers where weevil larvae feed on the nutrients, and plastic cells resembling bubble-wrap to hold hatched larvae. The cells are placed inside "sting cages" so female wasps can paralyze the weevil larvae as live food for their own hatching young. After growing for about 21 days, the new adult wasps are collected and shipped to researchers.

*Insect Rearing Research, Mississippi State, MS  
Jon Roberson, (601) 323-2230*

Yellow starthistle weeds in several western states now face two new species of insects that are the weeds' natural enemies. Starthistle stabs hikers, poisons horses and crowds out desirable plants that cattle would otherwise eat. It infests more than eight million acres in the West. One imported insect, a quarter-inch-long weevil known as *Larinus curtus*, has now settled in thistle-infested sites in California, Washington and Oregon. And the second biocontrol insect, the *Chaetorellia australis* fly, has established colonies in Oregon and Washington for the first time. Extensive testing by ARS scientists in California and Europe led to the successful start-up of American colonies of these insects--and three other starthistle-eating species that were introduced earlier.

*Plant Protection Research, Albany, CA  
Charles E. Turner, (510) 559-5975  
European Biological Control Laboratory,  
Montpellier, France  
Luca Fornasari/Javid Kashefi/Rouhollah Sobhian,  
33-67-04-56-00*

Bacteria that live in the roots of leafy spurge may turn out to be an enemy of this deep-rooted weed that's been hard to wipe out. Leafy spurge infests about 2.5 million acres of pasture and range in the northern Great Plains, and costs up to \$35 million annually in crop losses and chemical controls.



ARS scientists identified two beneficial bacteria, *Pseudomonas fluorescens* and *Flavobacterium*, that over-produce several plant hormones, harming the weed in the process. When the bacteria were turned loose on leafy spurge seedlings in the greenhouse, seedling emergence and root length were reduced 50 percent. In the spring, the scientists will evaluate the effect of the bacteria on weed seedlings in the field.

*Cropping Systems and Water Quality Research,  
Columbia, MO*

*Robert J. Kremer, (314) 882-6408*

**A natural fungus may be an environmentally safe way to stop a weed from infesting western rangelands.** A biological control for suppressing the weed is needed because herbicides that kill the weed also kill native range plants. ARS and Montana State University scientists have found a species of *Fusarium culmorum* fungus in Montana soil that rots the crown of medusahead weed, the namesake of the Greek monster Medusa. Greenhouse experiments show the fungus also prevents the weed from reproducing and greatly reduces its growth. Millions of small but spreading infestations of the weed occur across tens of millions of acres in California, Idaho, Nevada, Oregon, Utah and Washington. Medusahead replaces native range plants that are food for livestock and wildlife, while its barb-like seedheads lacerate the mouths of grazing animals. Scientists will next look for a *Fusarium* species more widely adapted in medusahead's homeground, the area between the Cascade, Sierra and Rocky Mountains known as the Great Basin.

*Conservation Biology of Rangelands Laboratory,  
Reno, NV*

*James Young, (702) 784-6057*

*Range Weeds and Cereals Research, Bozeman, MT*

*Paul Quimby, Jr., (406) 994-6850*

**Gaseous natural compounds from tomato and tobacco plants stopped the growth of two soil-borne fungi in lab tests.** One fungus, *Alternaria alternata*, causes leaf diseases on ornamental plants. The other, *Botrytis cinerea*, rots tomatoes and strawberries in storage. In lab tests, ARS and University of Kentucky scientists found that compounds, called volatiles, inhibited the germination and growth of fungal spores. The scientists isolated the compounds—chemically described as 6- and 9-carbon aldehydes and alcohols—from tomato and tobacco leaves. In nature, the plants release a blend of these volatiles immediately after being damaged or wounded, for example, by insects chewing. This may prevent diseases caused by fungi that initially enter a plant's wounds as spores. The scientists are continuing to study how—or if—they can harness the volatiles as nature-based fungicides.

*Tobacco and Forage Research, Lexington, KY*

*Roger A. Andersen, (606) 257-1902*

**About 2,000 packets of a vineyard pest's sex lure are sold yearly—a product of ARS patented research.** Grape growers can use lure-baited traps in early spring to see if skeletonizer pests will pose a threat to vineyards. If only a few adult skeletonizer moths are trapped, vineyard managers may decide not to spray insecticide. Pest control advisors and researchers can rely on the traps to gauge how well natural enemies are controlling the pest. About 10 years ago, ARS researchers isolated, synthesized and patented the sex lure, known as sec-butyl (Z)-7-tetradecenoate. Hercon Environmental Company of Emigsville, PA, manufactures it as a synthetic lure—or pheromone—impregnated in plastic strips hung in outdoor traps. Skeletonizer caterpillars feed on grape leaves; often, a skeleton-like inner layer of white leaf tissue and veins is all that remains.

*Horticultural Crops Research Laboratory, Fresno, CA*

*Edwin L. Soderstrom, (209) 453-3029*

*Cereal Product Utilization Research, Albany, CA*

*Ronald G. Buttery, (510) 559-5667*

**A recently discovered "family" of brain chemicals could help control insects ranging from cockroaches and corn earworms to stable flies.** Called neuropeptides, the natural chemicals are sent by the brain into the insect's body. There they attach to receptors, much like a key in a lock, to stimulate life-sustaining functions such as digestion or hibernation. ARS scientists discovered that a number of neuropeptides controlling various functions in different insects all share a common chemical core. In laboratory studies, the scientists were able to use a neuropeptide from one type of insect to stimulate unusually high production of natural sex attractants by a different insect. They also discovered the shape that the neuropeptides must assume to fit the receptor "lock" in the insects' bodies. Next, the scientists will study the chemical makeup of crucial compounds linked to the core to find non-peptides that can mimic the neuropeptide's action. Altered, manufactured versions of neuropeptides might be used to block receptors so natural neuropeptides can't "turn on" the necessary function. Or, these synthetic versions might be used to start the function too early or cause it to continue non-stop, ultimately destroying the insect pest.

*Food Animal Protection Research, College Station, TX*

*Ronald J. Nachman/G. Mark Holman, (409) 260-9315*

## Scientific Information Systems

**Satellite-generated maps** show where and how seriously flooding affected corn and soybean crops in the Midwest last summer. ARS researchers produced the information, which helped federal relief agencies deliver assistance to farmers in Illinois, Iowa, Minnesota, Missouri and other affected states. Using special computer software, the researchers projected satellite-derived images of the states onto maps every two weeks from early June to late August. The maps are color-coded to show the abundance—or scarcity—of crops, forest and other vegetation. The researchers evaluated flood damage by comparing the crops' color-indices for 1993 and 1992. A low-resolution satellite orbiting 537 miles above earth generates the images used to build the crop indices. The images are based on visible and near-infrared light wavelengths bouncing off crops and vegetation.

*Remote Sensing Research Laboratory, Beltsville, MD*  
*Paul Doraiswamy, (301) 504-6576*

**Municipalities and counties can collect data** on water flow and quality after storms using a measuring device that ARS engineers first developed for irrigated farms. Cities and counties with populations over 100,000 must provide such data to the Environmental Protection Agency when applying for permits for storm water collection systems. Now, the ARS-developed device is marketed by Campbell Scientific of Logan, UT, as a storm water discharge monitoring system for municipal and county engineers. Originally, the device was made to measure irrigation water flow to croplands. That way, farmers can apply only the amount of irrigation water needed, thus conserving limited water resources.

*U.S. Water Conservation Lab, Phoenix, AZ*  
*Albert J. Clemmens, (602) 379-4356*

**The 8.3-square-mile Goodwin Creek** research watershed near Oxford, MS, serves as a model for other sites in the \$30-million-a-year Demonstration Erosion Control (DEC) Project. One of six watersheds included in the project when it started in 1984, Goodwin Creek has 14 instrumented gauging stations. Each has a system to automatically collect and bar-code samples used to calculate sediment concentrations and yield. Twelve microcomputers relay this data back to the lab every 30 minutes. For every storm, each gauging station collects data on temperature, amount of runoff generated and the movement of gravel in the stream. The creek's extensive information on rainfall, runoff water, sediment yield and land use supports sediment-transport research of other DEC watersheds. The DEC project has expanded to 15 watersheds and involves thousands of miles of streams. Data from the project shows scientists how to do the best job of preventing erosion along channels at the

lowest cost. Principles and techniques learned from Goodwin Creek will serve as guides for future DEC activities.

*USDA National Sedimentation Laboratory, Oxford, MS*  
*Earl Grissinger, (601) 232-2924*

**Handheld infrared sensors** that take the temperature of plant leaves and then feed the readings to a computer might help plan irrigation for guayule, jojoba and lesquerella in the semi-arid Southwest. These plants show promise for commercialization, but growers need to know how to time irrigation applications to get the highest yield while saving water. ARS' technique for doing this is called crop water stress indexing. It shows when a rise in foliage temperature indicates higher water needs. Yields often can drop as much as 50 percent if plants suffer stress from insufficient water. ARS scientists originally developed the stress indexing for corn, wheat and other traditional crops. They are adapting it as part of the effort to establish guayule, jojoba and lesquerella as new, profitable, industrial crops. Guayule makes natural rubber for tires and latex products while the others contain natural oils for cosmetics and lubricants.

*U.S. Water Conservation Lab, Phoenix, AZ*  
*Francis S. Nakayama, (602) 379-4356*

**MoreCrop is available** as a new computer program that helps growers control wheat diseases. A grower enters into the computer information such as a field's geographic region, the field's agronomic zone, crop rotation, tillage method, planting date, irrigation (if any) and wheat variety. An on-screen response explains why a specific disease may or may not occur. Other on-screen information includes advice about chemical applications, if needed; a library on resistant wheat cultivars and rust races; maps and a glossary. ARS scientists plan to adapt MoreCrop to other areas of the United States including the Great Plains and the Southeast. MoreCrop, available on 3-1/2 inch computer disks, runs on IBM-compatible computers using Microsoft Windows version 3.0 or higher. Morecrop is available through Washington State University in Pullman.

*Wheat Genetics, Quality, Physiology and Disease Research, Pullman, WA*  
*Roland Line, (509) 335-3755*

**Cotton growers by 1995 could be using** a new ARS computer program that reduces pesticides to control bollworms and 12 other cotton pests. Growers would use the program—called WHIMS for (W)Holistic Insect Management System—to find out if, where, when or how much pesticide is needed, based on pest numbers. WHIMS is being designed to determine several options: whether pesticide applications are economically practical to control



small infestations, or whether spraying can be delayed if plenty of natural enemies are present. Computer recommendations will rely on the grower's field counts of pests and research-based data on ecology and behavior of cotton pests and beneficial organisms. WHIMS will be compatible with the ARS-designed GOSSYM/COMAX, a crop management system now used for over 500,000 acres of commercial cotton.

*Crop Simulation Research, Mississippi State, MS*  
*Terence L. Wagner, (601) 324-4378*

**Soil losses due to rain storms** will be forecast at a higher rate of accuracy in the eastern states as ARS scientists update rainfall-runoff data. ARS scientists found, while compiling data for the western states, that rainfall-runoff erosion (R) values needed fine-tuning. These values are the basis for the Revised Universal Soil Loss Equation (RUSLE) used by USDA's Soil Conservation Service to help farmers select erosion-preventing conservation practices in the far west. Now ARS-compiled data for several areas in the eastern states indicates that R values warrant updating. As an example, researchers recalculated R values from modern (1982-92) rainfall data taken from 29 standard recording rain gages in or adjacent to the 8.2-square-mile Goodwin Creek Watershed in northern Mississippi. Recalculated R values were 30 percent higher compared with those currently recommended for RUSLE. New data will help farmers comply with conservation practices in the 1985 and 1990 farm bills.

*National Sedimentation Laboratory, Oxford, MS*  
*Keith McGregor, (601) 232-2900*

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# Quarterly Report

of Selected Research Projects

April 1 to June 30, 1994

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

### Cooperative Research and Development Agreements

...With the Florida Department of Agriculture and Consumer Services, Jacksonville, FL, to develop environmentally friendly ways to attract and capture the Asian tiger mosquito, *Aedes albopictus*. It breeds in standing water in old tires, bird baths, clogged gutters and other containers. This species is thought to have spread to the United States from Asia in 1986 in scrap tires and is now found in 24 states. It spreads organisms that cause encephalitis, dengue and other viral diseases. Scientists will isolate and identify compounds that attract female mosquitoes and induce them to lay their eggs. The goals: to use the attractants to monitor *A.*

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

The report is now available in several electronic formats.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 414, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a particular company's product and/or research should be directed to the company itself.

*albopictus* populations and to combine the attractants with natural pathogens that kill the mosquitoes.

*ARS contact:* Daniel L. Kline, Medical and Veterinary Entomology Research Lab, Gainesville, FL, (904) 374-5933

...With Hach Company of Loveland, CO, to devise a rapid new lab test to measure salt levels and salt-sodium combinations in soil samples. High salt content, or salinity, stunts crops. A combination of excess sodium, low salinity and high pH--called high sodicity--causes crusting of the soil surface that cuts crop productivity and increases water runoff and erosion. ARS is developing ways to analyze salinity and sodicity using electrical measurements such as soil conductivity. That's in contrast to time-consuming chemical tests that require separating a sample into its liquid and solid portions. Hach is providing electrodes and other components and will manufacture the test.

*ARS Contact:* James D. Rhoades, U.S. Salinity Lab, Riverside, CA, (909) 369-4814

### Patent Licenses

...To VMRD of Pullman, WA, to commercialize an ARS-developed test for anaplasmosis, a disease that costs U.S. cattle ranchers up to \$300 million annually. Ticks transmit the *Anaplasma* parasites--microorganisms known as rickettsias--that carry the disease. The new diagnostic test is the first practical tool for reliably detecting all known strains of the parasite. Infected cattle die from the disease or become life-long carriers. Expensive DNA probes can reveal the parasites, but are impractical for testing large numbers of animals. The ARS test uses custom-built molecules called monoclonal antibodies to detect the parasites. Scientists are conducting studies to determine if the test also will work on sheep and goats. (PATENT APPLICATION 08/156,426)

*ARS Contact:* Donald Knowles, Animal Diseases Research, Pullman, WA, (509) 335-6022

...To Urbana Laboratories of St. Joseph, MO, to manufacture ARS' patented bacterial strain that boosts soybean yields up to seven percent more than do commercially available strains. Soybean farmers will be able to mix the improved strain into seed they plant next spring (1995). In a laboratory, ARS microbiologists bred and tested the new strain, a member of the *Bradyrhizobium* group of bacteria commonly found in soil. Soybeans and other legumes form lumps or nodules on their roots to house the *Bradyrhizobia*.

These bacteria extract nitrogen from the air and convert it to a form plants can use as food. The new strain excels because it produces more nodules on roots. (PATENT 5,021,076)

ARS contact: L. David Kuykendall, Soybean and Alfalfa Research, Beltsville, MD, (301) 504-5736; William J. Hunter, Crops Research Lab, Fort Collins, CO, (303) 498-4208

## Human Nutrition

In only 10 weeks, nursing home residents in their 80s and 90s walked faster, climbed stairs more easily and were more physically active after doubling their leg muscle strength through weight training. A study of 100 residents of a large, full-care center for the elderly in Boston's suburbs showed that high-intensity weight training is a feasible and effective means to counter muscle weakness, physical frailty and falls in the oldest old. That's good news for the approximately two million elderly living in nursing homes. The study also found that giving undernourished elderly high-calorie supplements to help reduce muscle loss won't increase their total calorie intake unless they exercise regularly. Half the participants worked hip and thigh muscles--important to mobility--during 45-minute sessions three days a week, while the other half participated in an activity or exercise of their choice. The exercise group increased the strength of thigh and hip muscles by 113 percent, improved their walking speed by 12 percent and their ability to climb stairs by nearly 30 percent, compared to little or no improvements in the non-exercisers. In addition, half of each group got a 360-calorie, high-carbohydrate drink each day, while the other half got a four-calorie placebo. The extra calories didn't further improve physical function in the exercisers. And the non-exercisers merely substituted the calories in the supplement for those from their normal food intake. ARS and the National Institute of Aging funded the study.

Human Nutrition Research Center on Aging at Tufts, Boston, MA

Maria Fiatarone, (617) 556-3075

To prevent osteoporosis later in life, little girls would benefit from increasing calcium intake several years before age 11. A study of 50 girls, age 5 through 16, shows that most bone formation occurs in the years just before and just after puberty begins. The first signs of puberty in U.S. girls can occur between age 8 and 11 with age 10 being average. Menstruation begins two to three years later, the average age being 12.5. Girls in the study had a rapid drop in bone formation within two years after menstruation. By age 15, very little bone was added. This suggests the current recommendations for increasing calcium intake to 1,200 milligrams (mg) in 11- to 24-year-olds may need to be

adjusted to begin at an earlier age. Four eight-ounce glasses of milk provide about 1,200 mg of calcium. According to the National Osteoporosis Foundation, half of American women over age 50 and three quarters over age 75 have significant bone loss. The concern is that these numbers may increase because milk consumption, and thus calcium intake, among young adolescent girls has dropped alarmingly over the last several decades--from about 1,400 mg daily in 1950 to 900 mg today.

Children's Nutrition Research Center, Houston, TX  
Steven A. Abrams, (713) 798-7000

A family history of diabetes may make it more important for women with low estrogen levels, like after menopause, to avoid consuming too much refined sugar than it is for men. A study of male and female rats--bred to become obese and develop diabetes--found that the females produce more of certain steroid hormones than males. These hormones, called glucocorticosteroids, hamper insulin from doing its job. A high-sugar diet increased production of the steroids even more. Estrogen blocks the insulin-depressing effect of the glucocorticosteroids. So the female rats actually had lower blood sugar levels than the males because they were protected by their high estrogen levels. But when estrogen levels drop as they do in women during and after menopause, higher levels of these steroid hormones may contribute to the onset of diabetes.

Beltsville Human Nutrition Research Center,  
Beltsville, MD

Paddy Wiesenfeld, (301) 594-5825 (now with the Food and Drug Administration, Rockville, MD)

Calcium supplements didn't reverse bone loss caused by anorexia nervosa in a study of teenage girls. Anorexia nervosa is a serious undereating disorder that affects some adolescent and young women. Of 13 teenage girls in the study, six were anorexic and hospitalized. Using stable (nonradioactive) isotopes of calcium, researchers measured how much of the mineral the 13 girls absorbed from their diets, excreted through the urine and deposited in or lost from their bones. The anorexic girls excreted four times more calcium daily than the control group. Most of the lost mineral came from bone. Also, they did not absorb any more calcium than the control group, even though they were getting more of the mineral through supplements. The anorexic girls had elevated levels of the hormone cortisol, which has been linked to a defect in the body's use of calcium. This indicates that treatment of the hormonal imbalance may be necessary to stem bone loss.

Children's Nutrition Research Center, Houston, TX  
Steven A. Abrams, (713) 798-7000

Senior citizens need the same amount of riboflavin--vitamin B2--as young adults even though they consume fewer calories, according to the first such study of older



people in their 60s and 70s. Riboflavin enables the cells to use oxygen to release energy from the amino acids, fatty acids and sugars we consume. The Recommended Dietary Allowances (RDAs) for riboflavin have been set a little lower for people over age 50 based on the assumption that because they eat less than younger people, they should need less of the vitamin. This study questions that assumption and shows the need for solid data for all age groups. Also, the study found that people in general need about 11 percent less riboflavin if they eat a vegetarian-type diet that is high in carbohydrates and low in fat compared to a high-fat, Western type diet. ARS collaborated with researchers in Guatemala, where more than half the rural elderly are riboflavin deficient. By increasing the riboflavin intake in the deficient subjects in small increments over a period of several months, researchers found the threshold--the amount that caused the subjects' excretion of the vitamin to jump significantly. This shows that the body is getting enough and is simply dumping the excess. The RDA for men under age 50 is 1.7 milligrams (mg) of riboflavin daily versus 1.4 mg for men over age 50. Younger women should get 1.3 mg versus 1.2 mg for older women. The richest sources are liver, American cheese, vitamin-fortified cereals, almonds and buttermilk.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Robert M. Russell, (617) 556-3139*

**A lifelong habit of walking about a mile a day can reduce the risk of osteoporosis in women--whether or not they engage in sports or other physical activities.** A year-long study of 238 healthy women past menopause found that those who had habitually walked more than 7.5 miles a week had denser bones, particularly in the legs and trunk, than those walking shorter distances. Also, the mile-a-day walkers had slower rates of bone loss in their legs during the study. Researchers measured bone densities in the 238 women and took detailed histories of their physical activities from age 14. The study was the first to correlate women's bone density with their walking history alone. An earlier study by others found a comparable correlation for all activities on foot up to age 50. Osteoporosis results from a long-term loss of bone minerals, which accelerates around the time of menopause, leaving the bones porous and prone to fracture. It also affects men and will increase as a health problem among men as they live longer.

*Human Nutrition Research Center on Aging at Tufts,  
Boston, MA*

*Elizabeth Krall, (617) 556-3074*

**Pound for pound, infants burn more calories than children or adults.** That's because a larger percentage of infants' body weight is devoted to organs--such as heart, liver, brain--which burn more calories than muscle tissue.

Adults, on the other hand, have a larger percentage of body weight devoted to muscle tissue. As a result, energy requirements from birth to adulthood don't increase at the same rate as body weight. The findings come from an ongoing study of daily energy expenditures of infants, children and adults while sedentary. Researchers here, at other ARS labs and at universities are collecting data on the amount of energy needed to maintain the body's vital functions while at rest, including metabolizing meals and doing minimal physical activity. Such data give a more precise basis for estimating daily calorie requirements than basal metabolic rate.

*Children's Nutrition Research Center, Houston, TX  
Nancy F. Butte, (713) 798-7000*

**Young women drinking an ounce of alcohol a day for three months increased blood levels of beta carotene and alpha carotene--both vitamin A precursors--but reduced levels of another carotenoid, lutein.** That's the finding from a six-month study of 18 healthy, non-smoking young women. They had no alcohol for the other three months. This is one in a series of collaborative studies between ARS and the National Cancer Institute that attempt to distinguish between the effects of alcohol and smoking on blood levels of carotenoids. Based on epidemiological studies, higher levels of beta carotene and related carotenoids in the blood are associated with lower incidence of lung and stomach cancers, the two cancers most linked to smoking and drinking. But the fact that smokers usually drink alcohol and drinkers often smoke muddies the picture. So researchers want to know how each habit affects carotenoid levels independently in order to better advise the public on how to reduce risk of certain cancers. Future studies will look at smoking independently and combined with alcohol.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*Gary Beecher, (301) 344-8356*

*National Cancer Institute, Bethesda, MD*

*Michele Forman, (301) 496-8559*

## Scientific Information Systems

**Farmers and scientists can now simulate the day-to-day progress of winter wheat on their personal computers.** MODWht3, a new ARS computer program, uses local weather data to predict crop characteristics such as the number and size of living shoots on the plants, or the total wheat yield and residue at harvest. This allows farmers to plan the best planting dates, row spacing and fertilization. MODWht3 is more powerful and user friendly than PLANTEMP, its predecessor. The simple, modular design of the model also allows computer programmers to modify the simulation for use with other crops. The simulation

runs on IBM-compatible computers with at least 640K of memory.

*Columbia Plateau Conservation Research Center,  
Pendleton, OR  
Ronald Rickman/Sue Waldman, (503) 278-3292*

**Pollution "hot spots" and environmentally sound farming practices** stand out with a new computer model that tracks the movement of pesticides and fertilizers as water flows over thousands of acres in a watershed. The model simulates water and chemical movement on a daily basis, year-round. Each watershed is subdivided into grids so that areas with the highest chemical runoff can be pinpointed. Knowing the source enables state agencies to accurately recommend needed changes in farming practices. The model, called ANN-AGNPS for Annual-Agricultural Nonpoint Source pollution, also allows a comparison of farming practices to see which result in the least loss of chemicals to groundwater, rivers and lakes. Earlier versions of the still-developing model are in use by the U.S. Environmental Protection Agency. The software has been requested by people in every state, ranging from government agencies and environmental consultants to lakeshore property owner associations.

*North Central Soil Conservation Research Lab,  
Morris, MN  
Robert A. Young, (612) 589-3411*

**Written data and full-color video images of corn ears** appear in Corn-Base, a prototype computerized catalog developed by ARS and Iowa State University researchers. Corn-Base will help researchers and plant breeders select desirable traits from corn germplasm accessions at the North Central Regional Plant Introduction Station at Ames, IA. Researchers adapted commercially available software and wrote some software of their own to digitize and put the images on CD-ROM disks and other data storage devices. Plant breeders and others now can access only written data using USDA's Germplasm Resources Information Network (GRIN). Corn imagery, along with the GRIN data, will become accessible when improved means of high-speed information transfer via personal computer-modem links become available.

*Plant Introduction Research, Ames, IA  
Peter K. Bretting, (515) 294-3255*

**Yields are up by as much as 28 percent** in some fields, report farmers in a pilot project to test a new computer model for soybean growers. The increases are due to the model's accuracy in timing irrigations. Known as GLYCIM, it is being tested by four farmers and county extension agents in Mississippi. It advises irrigation whenever dry weather threatens losses of at least three bushels an acre. One farmer with a 28 percent yield increase also found he saved water and time by irrigating

before the soil got so dry it cracked. It took less than 36 hours to get water completely across the field, compared to four to five days for a nearby field that was irrigated later than the model recommended. The model also predicts total yields, usually accurate to within five bushels an acre for certain varieties. Test sites have portable weather stations so the model can adjust predictions on an hourly basis throughout the 140-day, soybean-growing season. Since 1991, the Mississippi Soybean Promotion Board has paid for all on-farm testing of GLYCIM. Testing will expand to other states next year. In addition to irrigation, the model advises farmers in every aspect of growing soybeans, from variety selection to planting and harvest dates to the application of pesticides and fertilizers.

*Systems Research Lab, Beltsville, MD  
Vangimalla R. Reddy, (301) 504-5806*

### New and Improved Products

**Corn bran may be a source of new compounds** similar to those present in rice bran that appear to lower blood cholesterol and blood fat levels in humans. ARS researchers previously discovered members of a class of compounds called sterol esters in corn kernels' outer layers or bran. When scientists began developing a way to separate these sterol esters from the bran, they uncovered 10 other types of sterol esters in the corn bran as well. Refined corn bran is used as an ingredient in some diet food plans and breakfast cereals to provide dietary fiber.

*Mycotoxin Research, Peoria, IL  
Robert A. Norton, (309) 681-6251*

**Printing inks of 100-percent soybean oil** are more biodegradable than inks made with commercial mineral oil or a soy-mineral oil blend. Biodegradability is important in preventing the inks in discarded printed material from posing an environmental waste problem. ARS ran tests of three ink formulations: the ARS 100-percent soy oil ink, the soy ink developed by the Newspaper Association of America (NAA), and a commercial petroleum-based ink. They ran the tests to see how thoroughly three different soil microorganisms broke down the inks. Results: 80 percent of ARS' patented 100-percent soybean oil ink vehicle degraded, compared with 30 percent for the NAA soy ink vehicle, which uses about 67 percent soy oil. Only 16 percent of a petroleum-based ink vehicle degraded. (PATENT 5,122,182)

*Oil Chemical Research, Peoria, IL  
Marvin O. Bagby/Sevim Z. Erhan, (309) 685-4011*

**Nutrition-rich dry beans might increasingly be used** to produce flour in the food industry. ARS scientists have shortened the steps for making flour from raw beans--good sources of protein, fiber, folate (a B vitamin), iron, phos-



phorus, potassium and magnesium. Bean flour made from this streamlined process could be a candidate ingredient for soups, gravies, breads, muffins, hot and cold cereals, pancakes, cookies and other foods. The researchers made the flour in a machine called a twin-screw extruder. It converts freshly ground, raw beans into a crisp, rope-like strand that is passed through a mill to yield light, fine-textured cooked flour. In experiments, the process took about 10 minutes. The traditional method for converting beans into cooked flour takes much longer because it requires soaking, cooking and mashing dry beans into paste that then is dried and ground. Extrusion uses less energy and leaves no cooking wastewater to pose disposal problems. Researchers tested extrusion only with small white beans, but they also expect it to work with other kinds.

*Cereal Product Utilization Research, Albany, CA*

*Richard H. Edwards, (510) 559-5852*

**Leaner meat products could result** from combining freeze-drying and supercritical fluid extraction (SFE) in meat processing. In tests, SFE was effective in reducing both fat and cholesterol from freeze-dried, precooked hamburger patties. SFE uses pressurized carbon dioxide to reduce the fat and cholesterol. For years, the food industry has used SFE, for example, to decaffeinate coffee and extract beer hops. Tests run by ARS scientists, in collaboration with University of Illinois meat scientists, showed that non-toxic carbon dioxide could produce a meat product lower in fat and cholesterol while retaining enough fat to meet taste requirements of health-conscious consumers. (PATENT 5,151,188)

*Food Quality and Safety Research, Peoria, IL*

*Jerry W. King, (309) 681-6203*

**Compounds that make bean proteins harder to digest** are easier to detect using a new test developed by ARS scientists. In people and animals, tannins inhibit the body's ability to absorb protein from fava and other beans. This is a nutritional problem in parts of Africa, where the fava bean is an important protein source for humans, and in other parts of the world where the beans are used as animal feed. The ARS test uses a process called nylon chromatography to measure tannins by sampling bean seed testa--the only part of the bean where tannins are found. This gives a more accurate picture of tannin levels than current methods which measure tannins in the entire seed. The new test could provide the basis for commercial testing of tannins--and could help breeders develop beans with lower tannin levels.

*Tropical Agriculture Research Station,*

*Mayaguez, Puerto Rico*

*Lehel Telek/Philip N. Miklas, (803) 831-3435*

**Coatings now used to preserve fresh fruit** may also protect it against pests inside the fruit as well as on its surface. ARS scientists used the coatings alone and in combination with hot air treatments to suppress Caribbean fruit flies. These coatings could be an alternative to the fumigant methyl bromide. Pests such as the Caribbean fruit fly (*Anastrepha suspensa*) must be controlled so fruit can be shipped to areas where the fly doesn't exist and might survive. ARS scientists, in grapefruit tests, found several different coatings for freshness now used by the packing industry killed 33 to 100 percent of Caribbean fruit fly larvae. Nature Seal, one of the coatings, was developed and patented by ARS scientists at Winter Haven, FL. Grapefruit treated with Nature Seal and uncoated grapefruit were subjected to air heated to 118.4 degrees for 60 minutes. That combination killed 100 percent of the larvae, while the heat alone killed 76 percent. Coatings are being experimentally combined with other treatments such as cold storage, irradiation, fumigation and insecticides and are being tested on guavas, carambolas and mangoes.

*Subtropical Horticulture Research Lab, Miami, FL*

*Guy J. Hallman, (305) 254-3624*

**New fruit coatings developed by ARS scientists** keep citrus fresh for at least three weeks at room temperature. Wax, also used by Mother Nature to coat fruits and vegetables, is the main ingredient. Minimum amounts of resins are also used. All ingredients have been approved by the FDA. In lab tests, coated oranges and grapefruit looked good and showed no signs of deterioration. Fruit treated with commercial coatings appeared shrunken and discolored after the three-week period. Another advantage of the new coatings: Fewer off-flavors develop.

*Citrus and Subtropical Products Research Lab,*

*Winter Haven, FL*

*Robert D. Hagenmaier, (813) 293-4133*

## Animal Production and Protection

**White meat in poultry, relatively low in fat,** could be made leaner still. Dark meat's higher fat content also could be lower, now that a new, reliable ARS test can measure a muscle growth-promoting hormone in poultry. Called insulin-like growth factor-1 (IGF-1), the hormone is responsible for muscle growth in mammals and poultry, but differs somewhat between the two. Until now, a test for the mammal form of IGF-1 was the only one available. Accurate measurement of the poultry form of IGF-1 will help researchers determine which birds put on more muscle and thus make leaner meat. Farmers and consumers would benefit from reducing the fat chickens add under the skin, between the muscles and in the abdomen. Abdominal fat

mass is discarded at processing, but costs poultry farmers an estimated \$500 million annually in extra feed.

*Nonruminant Animal Nutrition Lab, Beltsville, MD*  
*John P. McMurtry, (301) 504-8803*

**A simple blood test could help cattle producers** cut herd feeding costs without a loss in production. Cost savings came from reducing protein supplements. Blood urea nitrogen (BUN) levels are a good indicator of whether the herd's diet has the proper ratio of protein to energy. In ARS field tests, pregnant cows whose level of protein supplementation was based on BUN levels ate 22 pounds less supplement per animal through the winter. Yet, the cows showed no adverse effects on calf weaning weights or ability to breed again. They were compared with cows receiving a standard program of protein supplementation.

*Subtropical Agricultural Research Station,*  
*Brooksville, FL*  
*Andrew C. Hammond, (904) 796-3385*

**Dairy farmers could see their herd's feed costs decline** greatly within the next decade. The difference: future corn hybrids bred specifically for silage--a major source of dairy cattle feed--to replace current hybrids developed primarily for grain. ARS scientists tested 45 breeding lines of corn for fiber qualities and found lines that would digest twice as well as others in artificial cow rumens. Plant breeders could use such lines to develop new corn hybrids. Limited digestibility of current corn silage and other sources of forage fiber reduces cows' efficiency in using feed to make milk unless diets are supplemented with more expensive grain.

*Plant Science Research, St. Paul, MN*  
*Hans-Joachim G. Jung, (612) 625-8291*

**Adding alum to poultry litter** could result in healthier chickens, a cleaner environment and a healthier bottom line for poultry growers. Litter from poultry house floors is often used as fertilizer on farmland. But in the poultry house, nitrogen in the litter evaporates into ammonia. As a result, the litter that's applied as fertilizer is overloaded with phosphorus that can run off, threatening the ecosystem of waterways. Also, the nitrogen-turned-ammonia in poultry houses can cause serious health problems for the birds. ARS tests showed alum mixed into litter bound virtually all the phosphorus into a non-soluble form, and also reduced nitrogen changes. A plus: Retaining the nitrogen increases the litter's market value as fertilizer. (PATENT APPLICATION 08/129,742)

*Poultry Production and Product Safety Research,*  
*Fayetteville, AR*  
*Philip A. Moore, Jr., (501) 575-2104*

**Cattle's gluttonous eating of a poisonous weed** known as larkspur has now been linked to summer storms. Larkspur poisons more than 3,000 cattle each year on western mountain rangeland. ARS range scientists have checked for storm signals--dropping barometric pressure and temperature, high humidity, rain and leaf wetness. Such signals frequently accompany times when cattle begin eating too much larkspur. Scientists don't yet have an explanation for this phenomenon. To protect cattle, ranchers use herbicides on dense patches of the weed, and keep cattle off the range until larkspur matures and is less toxic. Also, ranchers could use sheep, which aren't affected by larkspur, to "pre-graze" infested range before cattle are released.

*Poisonous Plant Research Lab, Logan, UT*  
*Lynn F. James, (801) 752-2941*

**Leaner chicken and ham** could result from feeding animals an amino acid. ARS and University of Maryland, Eastern Shore (UMES) scientists have applied for a patent on this use of N-methyl aspartic acid (NMA), a modified form of the amino acid aspartate. NMA tells the body to secrete more growth hormone. That hormone stimulates the production of protein and suppresses the production of fat. When UMES scientists fed the amino acid to chickens, the birds were found to have less fat than chickens given the same diet but without NMA. ARS scientists consulted with university researchers on the design of the experiment and analyzed the blood for growth hormone and insulin-like growth factor-I, a hormone responsible for muscle growth in mammals and poultry. (PATENT APPLICATION 08/099,576)

*Non-Ruminant Animal Nutrition Lab, Beltsville, MD*  
*John P. McMurtry, (301) 504-8803*  
*Animal Physiology Research, Athens, GA*  
*Claude R. Barb, (706) 546-3226*  
*Department of Agriculture, UMES*  
*Jeannine Harter-Dennis/Mark Estienne,*  
*(410) 651-6194*

**Putting sheep and cattle together on the range** can help prevent coyote attacks on the sheep without the need for expensive wire fences. Sheep losses from coyotes currently cost ranchers nearly \$5 million each year. But an ARS study on New Mexico rangeland confirmed that coyotes steered clear of sheep because they were intimidated by 1,200-pound cows. Researchers had bonded the sheep to cows at an early age, so they grazed together and better utilized range forage. Cattle eat mainly grasses, while sheep prefer weeds and some shrubs. Such bonding also helps guard dogs--the backbone of the protection program on the Jornada Range.

*Jornada Experimental Range, Las Cruces, NM*  
*Dean M. Anderson, (505) 646-4842*



**New genetically engineered vaccines** for Japanese encephalitis will be field-tested in swine now that the vaccines have protected mice and pigs in laboratory tests. The vaccines are based on two harmless poxviruses: vaccinia virus, the virus employed in the eradication of smallpox, and canarypox. The two poxviruses have been altered to carry genes for proteins that appear on the coat of Japanese encephalitis virus (JEV)--just enough JEV "input" to stimulate the vaccinated animal's body to produce antibodies to fight JEV. Existing commercial vaccines--derived from the brains of mice infected with JEV--can stunt the growth of vaccinated pigs and can cause severe allergic reactions in humans. The new poxvirus vaccines were developed and tested in collaboration with researchers at Yale University School of Medicine and a U.S. vaccine company, Virogenetics Inc. of Troy, NY.

*Plum Island Animal Disease Center, Orient Point, NY  
Peter W. Mason, (516) 323-2500*

## Biological Control

**Wasps and flies imported to fight gypsy moths** may do their best work when released among trees and shrubs that have tiny nectar glands on the leaves. ARS scientists found more parasitized gypsy moth pupae (a pre-moth stage) and caterpillars on poplar, wild cherry, viburnum and other plants having these glands. Called extrafloral nectaries, the glands typically are located on leaves where the blade meets the leaf stem. The sugary nectar may attract beneficial wasps and flies in larger numbers to feed on gypsy moths infesting trees and shrubs, the scientists suggest. Field studies of the *Cotesia melanoscelus* wasp and the *Parasetigena silvestris* fly were done in Korea where they are the two most important insect parasites of gypsy moths. These beneficial insects are already established in the United States; additional releases, to boost their numbers, should be made on trees or shrubs that have the special nectaries. In the past 70 years, gypsy moths have defoliated trees on more than 52 million acres in the United States.

*Aquatic Weed Control Research, Fort Lauderdale, FL  
Robert W. Pemberton, (305) 475-0541*

*Plant Science and Water Conservation Lab,  
Stillwater, OK*

*Jang-Hoon Lee, (405) 624-4407*

**Not all thrips are insect pests of flowers, ornamentals and agricultural crops.** Some are beneficial as predators of mites and insects and as pollinators of crops. ARS and University of Florida research showed for the first time how thrips pollinate West Indies mahogany tree flowers in Florida. These hardwood trees are grown in the tropics for their valuable wood or as ornamentals along road sides. Five species of thrips were the only insects found in 12 to

59 percent of flowers collected from seven sites located many miles apart. Their bodies were coated with pollen providing the first evidence that thrips were involved in cross pollinating these trees. Further studies are needed to find out how effective and important these insects are as pollinators. This information will be used by botanists and horticulturists who work on breeding for improvement of mahoganies and other U.S. crops. It will also aid scientists working on thrips biology as a means of strengthening pest management systems.

*Systematic Entomology Lab, Beltsville, MD  
Sueo Nakahara, (301) 504-6893*

**Tiny flea beetles that ARS imported from Europe** have made a small but impressive start at gobbling up the aggressive weed leafy spurge on U.S. rangeland. Spurge infests about five million acres in the Northern Plains, costing ranchers more than \$100 million a year. When ARS scientists released 500 *Aphthona* beetles in one spot, the spurge-hungry insects multiplied, nearly eliminating the weed from an area 88 by 100 yards after four years. In the same length of time at another site, one of this flea beetle's cousin species reduced spurge from 57 percent to less than one percent of the ground cover. ARS researchers now are helping other federal and state agency personnel establish flea beetle colonies at other sites on the Plains. Overseas, ARS biocontrol researchers search for and test additional *Aphthona* species, including some from China. Spurge-infested areas currently double every seven years. Cattle and horses generally won't graze the weed and sometimes even refuse to eat good forage next to spurge plants.

*Range Weeds and Cereals Research, Bozeman, MT  
Paul C. Quimby, Jr., (406) 994-6850*

**A stinkbug, a bacterium and a fungus teamed up** and did just as good a job as insecticides in protecting potato plants from attack by Colorado potato beetles. In an experiment last summer in Maine, ARS and University of Maine researchers tried the environmentally friendly trio in plots of Atlantic and Superior potatoes. The study was likely the first to employ all three of these biocontrol agents. Follow-up tests will fine-tune their use. Colorado potato beetles cost U.S. potato growers an estimated \$75 to \$100 million a year to control. The bacterium, *Bacillus thuringiensis*, is harmless to humans but carries a toxin into the potato beetle's stomach. The *Beauveria bassiana* fungus penetrates the beetle's skin-like cuticle, then kills it by feeding on its innards. *Perillus bioculatus* stinkbugs--black and white or red and black with shield-like marks on their backs--eat hundreds of the potato beetle's bright orange eggs. They also gobble up many immature beetles that hatch from the eggs.

*Fruit and Vegetable Insect Research, Yakima, WA  
K. Duane Biever, (509) 575-5877*



Spores of a fungus that are grown in corn oil react like Popeye did to spinach--the spores knock out the weed hemp sesbania. ARS field studies left no doubt--spores formulated in unrefined corn oil killed over 92 percent of northern hemp sesbania. Scientists sprayed the spores from the fungus *Colletotrichum truncatum*, a natural weapon against the weed. When spores are grown in the corn oil, spray volume needed for maximum control can be cut from 20 to five gallons an acre. Another plus: The spores need only two hours of dew--compared to the previous eight-hour requirement--to control the weed, which plagues soybeans, corn and rice crops. Laboratory analysis is underway to identify the compound in corn oil that increases the fungal spores' effectiveness. (PATENT 5,034,328)

*Southern Weed Management Research, Stoneville, MS  
C. Douglas Boyette/G.H. Egley, (601) 686-5217*

ARS scientists are devising strategies using compounds from two microorganisms that may someday serve as weed killers or fungicides. First, the fungus *Alternaria alternata* produces a natural herbicide called tentoxin, which disrupts cell growth in most soybean weeds and in johnsongrass in corn. ARS scientists ran tests that showed tentoxin had no adverse effect on soybeans or corn. Second, the bacterium *Bacillus subtilis* produces a natural fungicide, iturin, that was tested against a number of plant pathogens, such as *Fusarium* and *Aspergillus*, which affect a variety of agricultural commodities. The next step: finding ways to produce the compounds for an economical alternative to chemical herbicides and fungicides.

*Environmental Technology Research, New Orleans, LA  
Alan Lax, (504) 286-4382*

A new tissue culture method to grow insect intestinal cells should prove valuable in investigating potential of biocontrols, such as viruses or bacteria against pests. Developed by ARS scientists, the method supports growth and maturation of intestinal cells from tobacco hornworms. Since virtually all pathogens enter the caterpillars through their digestive tract, identification of pathogens that inhibit growth or destroy intestinal cells in a culture system should prove a relatively inexpensive first step before whole-animal and field tests of pathogens are undertaken.

*Insect Neurobiology and Hormone Lab, Beltsville, MD  
Marcia J. Loeb, (301) 504-8103*

## Crop Production and Protection

Red Dye No.3, a limited-use food coloring, may be a new weapon against pests like the Mediterranean fruit fly. ARS laboratory tests originally used the dye in a bait formula to see if apple maggot flies--from the same family as Med-flies--ate an experimental bait. ARS scientists found for

the first time that the dye, on its own, killed the apple maggot flies exposed to light. Deaths were higher after flies ate higher concentrations of red dye in the food or faced longer exposure to light. Light-activated toxicity has been known to occur in other insects, including house flies. Scientists added the dye (erythrosin B) to a bait formula including naturally produced toxins from fungi. Flies feasting on the dye and sucrose died within a few hours after exposure to light, even when no fungal toxins had been added to the bait.

*Plant Protection Research, Ithaca, NY  
Stuart B. Krasnoff, (607) 255-7744*

Experimental genes may enable barley to resist one of its five worst disease enemies--barley yellow dwarf virus. University of California scientists who work at an ARS lab in California refined and simplified "gene-gun" techniques for giving barley these and other new genes. They are first to publish a reliable procedure other scientists can use to gene-engineer barley. Grains such as barley--known as monocots--have proven more difficult to bioengineer than potatoes, tomatoes and other crops called dicots. Scientists employed the gene gun to fire gene-coated gold pellets into not-yet-mature barley embryos placed on lab petri dishes. Neither the gun nor the plant embryos are new to plant bioengineering. But the scientists fine-tuned their use for this crop, propelling new genes into barley embryos and nurturing them into more than 500 healthy, fertile plants. Now, an ARS scientist in Idaho is directing tests in that state and in California and Illinois to scrutinize the biotech barley's virus resistance. Purdue and Washington State University scientists provided the test genes that may boost resistance. Coors Brewing Company of Golden, CO, funded some of the research through a cooperative research and development agreement with ARS.

*Plant Gene Expression Center, Albany, CA  
Peggy G. Lemaux, (510) 559-5923  
National Small Grains Germplasm Research,  
Aberdeen, ID  
Phil Bregitzer, (208) 397-4162*

Seven-foot-tall soybean plants--about twice as tall as average soybeans--could become a new sustainable-farming crop for dairy farmers in the mid-Atlantic region and the midwest. An ARS scientist has bred several experimental lines as a silage crop. Silage is made from plant leaves and stems "pickled" by natural microorganisms to create a long-lasting, nutritious feed. Corn is the number one silage, but the soybean plant can produce more protein. And unlike corn, soybean is a legume and thus makes a natural form of nitrogen fertilizer. It would be available in the soil to nourish a small grain, like barley or wheat, planted after the soybeans are cut for silage. For several years ARS has tested silage soybeans jointly with scientists at The Pennsylvania State University and Virginia Polytechnic Institute and



State University. This year, cooperative studies began at Iowa State University, University of Minnesota, University of Wisconsin, University of Kentucky, University of Missouri, and Ohio State University at Wooster.

*Plant Molecular Biology Lab, Beltsville, MD*  
*Thomas Devine, (301) 504-6375*

**Velvetleaf and other large-seeded, broadleaf weeds** were controlled in corn fields by applying herbicide granules that include dicamba. Using small granules with dicamba will lower the amount of herbicide needed for weed control. This savings plus the advantage of less leaching of herbicide will lower the potential threat to groundwater contamination. Some weed seeds are difficult to control with one herbicide. To test the best combination of herbicides and the application method, a three-year field study compared the liquid versus starch-encapsulated granule forms of several herbicides in various combinations. Smaller-sized granules provided better control than did large ones, especially since they more effectively controlled velvetleaf, a particularly troublesome weed. The best control (90 percent) was obtained by a mix of dicamba, atrazine and alachlor or metolachlor, when applied to the surface of corn fields or incorporated into the soil before planting. Corn yields were the same all years for all formulations and for both application methods.

*Insect and Weed Control Research, West Lafayette, IN*  
*Marvin Schreiber, (317) 494-4656*

**What's the level of growth hormone in a plant?** If the hormone amounts in plant varieties were known, that could lead to breeding or genetically tailoring crops for faster growth rates, earlier harvests and greater yields. Now, ARS and University of California scientists have found a way to measure the hormones indolebutyric acid (IBA) and indoleacetic acid (IAA) in tobacco plants used as a model. Previously it was known that these two hormones promote root growth in herbaceous and woody plants. But the amounts in plants could not be determined. Using analytical lab instruments, scientists purified plant tissue samples and determined the precise amounts of IBA and IAA in a tobacco leaf. Researchers are also using the technique on carrots. Grants from the U.S.-Israel Binational Agricultural Research and Development Fund and the National Science Foundation supported the research.

*Horticultural Crops Quality Lab, Beltsville, MD*  
*Jerry D. Cohen, (301) 504-6128*

**A new bait for corn rootworms** used 95 to 98 percent less insecticide than conventional sprays to suppress the pests--the target of almost half the insecticides used in row crops in the United States. Adult corn rootworm beetle populations dropped from 10 or more per plant to less than one, on

average, in three years of bait tests on 16-square miles of private farmland in South Dakota. As a result, the number of eggs laid by the beetles in the ground each fall was reduced similarly. For most fields, this reduced the need for soil insecticide to kill the emerging larvae. ARS developed the bait in cooperation with private industry and state experiment stations in five Midwestern states. Less than an ounce of carbaryl insecticide per acre is used in the bait, which is sprayed on corn leaves. Dried and ground roots of wild buffalo gourds are mixed with carbaryl so beetles will eat the bait compulsively. But the bitter cucurbitacins in the gourd roots are not attractive to ladybugs, bees and other beneficial insects. Recommendations for using the bait throughout the Corn Belt will be developed in combination with a beetle monitoring program so farmers can decide if and when to spray.

*Northern Grain Insects Research Lab, Brookings, SD*  
*Larry Chandler, (605) 693-5239*

**Gnats that look like miniature mosquitoes** might be to blame for some failed clover crops in the Mid-South. Clover is a desirable addition to pastures because it offers an additional protein source to grazing animals. Also, it boosts soil nitrogen levels. But clover is sometimes tricky to establish. Now ARS scientists have discovered a natural stumbling block: Dark-winged fungus gnats, *Bradysia impatiens*, have an oversized appetite for clover seedling roots. In one greenhouse study, the gnats damaged 96 percent of kura clover, 92 percent of white, ball and arrowleaf clovers, 84 percent of red clover, 72 percent of crimson clover and 43 percent of subterranean clover. Adult gnats lay their eggs on the soil surface near the clover seedling; emerging larvae feed on the plant roots. Another threat: The wounds the gnawing larvae create on roots may be wide-open doors to secondary infections from soil microorganisms.

*South Central Family Farms Research Center,*  
*Booneville, AR*  
*Tim L. Springer, (501) 675-3834*

**Range grasses produce 10 times more forage** on hillsides that have been cleared of wild junipers. A recent experiment on Steens Mountain in southern Oregon indicates just how big a pest juniper--a native plant--has become. In the past century, ideal climate and suppression of wildfires have vastly increased the mountain's juniper density--from, typically, one or two trees per acre to as many as 8,000 per acre. ARS scientists have been working with the federal Bureau of Land Management, Oregon State University researchers, ranchers and environmentalists on ways to remedy the juniper problem while preserving Steens Mountain for grazing and other uses. ARS and OSU scientists cut the juniper on half of eight two-acre plots. Two years later, the cut plots produced 300 pounds of

forage per acre compared to only 30 to 40 pounds on the uncut plots.

*Range and Meadow Forage Management Research,  
Burns, OR  
Tony Svejcar, (503) 573-2064*

**Rose chafers, insects often seen destroying grape crops** in Great Lakes states, may be lured to traps baited by a synthetic floral aroma commercially produced by a licensee of a patent jointly owned by ARS and the Ohio Agricultural Research and Development Center. Scientists used the attractant to monitor chafer populations as grapes bloomed and developed in Pennsylvania and northeastern Ohio vineyards. Research conclusion: Trapping year after year may remove enough rose chafers to allow growers to occasionally skip pesticide applications on blooming vines. Adult chafers also feed on peonies, blackberries, raspberries, pears, apples, plum cherries, corn, Scotch pines and many ornamentals.

*Application Technology Research, Wooster, OH  
Michael G. Klein, (216) 263-3896*

**Better control of the Hessian fly may come from research** to map the pest's genes. The Hessian fly is the most destructive insect pest of wheat in the United States, causing crop losses of about \$100 million each year. Losses in Georgia alone for 1989 were estimated at \$28 million. ARS and Purdue University scientists are mapping the location of specific pieces of genetic material, called DNA, on the insect's chromosomes, especially in those flies that have evolved so that they can live on wheat bred for resistance. This will help scientists learn about the genes that allow the insect to live on resistant wheat. Also, the information will help breeders engineer wheat that remains resistant to the Hessian flies as they change.

*Insect and Weed Control Research, West Lafayette, IN  
Richard H. Shukle, (317) 494-6351*

**A bacterium, *Xylella fastidiosa*, has been pinpointed** as the cause of a destructive and rapidly spreading disease of citrus in Brazil. ARS research linking the bacterium to citrus variegated chlorosis (CVC) is a major step toward developing a way to diagnose it. This should help prevent its introduction into the United States. Other strains of *X. fastidiosa* limit production of grapes and plums in the southeastern United States. And some strains of the bacterium also cause diseases of other woody plants. CVC had been associated with the presence of *X. fastidiosa*, but the bacterium's role as the disease-causing culprit was unknown until the ARS research. Various leafhoppers transmit the bacterium to citrus. Symptoms on sweet orange trees include mottled leaves and plant stunting. Also, fruit are reduced in size and become very hard.

*Fruit Lab, Beltsville, MD  
John S. Hartung, (302) 504-6374*

**Treating freshly harvested switchgrass seed** with a sulfuric acid "bath" can speed up germination--alleviating the problem that few of these seeds sprout right away. Switchgrass seed matures in the fall and will not germinate well for about a year after harvest. Speeding germination allows faster progress in breeding programs and may also improve field establishment of fall-harvested switchgrass planted the following spring. In laboratory tests, ARS scientists compared freshly harvested Alamo switchgrass seed soaked in sulfuric acid for 10 minutes and in chloroethanol for 15 minutes. Both treatments increased germination equally well. But chloroethanol is highly toxic, so researchers tapped sulfuric acid as the treatment of choice. Acid treatments also improved germination of freshly harvested seed of switchgrass cultivars Caddo and Kanlow with no detrimental effect on seedling vigor.

*Grassland, Soil and Water Research, Temple, TX  
Charles R. Tischler, (817) 770-6523*

**A new red raspberry and a phlox flower** have been bred as cold-hardy plants for the northern Great Plains. 'Plainsman' red raspberry begins bearing fruit the first week in August, three to four weeks before other varieties. 'Helene' phlox is a perennial with fragrant pink flowers. Horticulturist Gene Howard, who completed developing both plants after retirement from ARS, donated them to the agency. Free breeding material is available from ARS to researchers and nursery industry people.

*High Plains Grasslands Research Station, Cheyenne, WY  
Gerald E. Schuman, (307) 772-2433*

**Cassaba melons that fight off damaging mildew diseases** in the humid Southeast are now available to breeders. ARS and the Georgia Agricultural Experiment Station have released a light-orange flesh cassaba melon line called C931 that resists powdery and downy mildew. It is the only cassaba melon germplasm to have mildew resistance in Georgia and South Carolina growing regions. Most domestic cassaba melons are now grown in arid counties of California, while the rest are imported from Israel and other countries. South Carolina and Georgia field tests showed 80 to 90 percent of C931 plants survived both mildews without chemical fungicides, while susceptible melons were wiped out. C931 typically produces one to four melons per plant, each weighing from four to six pounds.

*U.S. Vegetable Lab, Charleston, SC  
Perry E. Nugent, (803) 556-0840*

**A newly named potato variety** called Chipeta yields light, tasty and attractive potato chips--plus a host of other qualities desired by consumers and the potato industry. ARS, Colorado State University and University of Idaho researchers developed Chipeta, released last year. That followed 10 years of field-planting by researchers and growers plus several years of chip-making by some of



America's leading snackmakers. Chipeta chips are generally free of bruises, burnt edges and unwanted bubbles that form during deepfrying. Also, high starch content means the chips absorb less oil. Chipeta is now grown in Arizona, California, Colorado, Idaho, Minnesota and North Dakota. Yields usually top those of standard varieties like Atlantic and Norchip. Chipeta plants require less nitrogen fertilizer than many other chipping types, reducing the potential for polluting water. And harvested tubers hold up well in cold storage.

*Small Grains and Potato Germplasm Research,  
Aberdeen, ID*

*Dennis L. Corsini/Joseph J. Pavek, (208) 397-4181*

*San Luis Valley Research Center, CO*

*David G. Holm, (719) 754-3594*

*Aberdeen Research and Extension Center, Aberdeen, ID*

*Stephen L. Love, (208) 397-4181*

**Cotton and other crop seeds can now be planted at a precise depth and the soil tamped down at a specified pressure, regardless of changes in soil's hardness from a wet valley to a dry, hard hillside.** ARS scientists invented a hydraulically controlled attachment that can do this, increasing the chances of seed germinating and emerging. Current depth-control devices typically are set for the toughest soils and can't easily be readjusted. They also might set seeds too deep on soft soils--or excessively compact the seed trench. By contrast, planting depth and pressure on ARS' implement are easily preset, as shown in tests in California fields. For the experiments, scientists bolted the mechanism to a planter that they hooked to a tractor's tool-bar frame. But it could also be used for on-the-go adjustments of tillers, cultivators, plows and fertilizer and pesticide applicators. (PATENT 5,234,060)

*Cotton Research Station, Shafter, CA*

*Lyle M. Carter, (805) 746-6391*

## Soil, Water and Air

ARS scientists have developed monitoring equipment and mathematical technology to measure emissions of greenhouse gases. These gases are associated with global warming predictions, such as methane from landfills and cattle and nitrous oxide from farm fields. The first tryout of the technology was with grazing cattle in Canberra, Australia. ARS and Australia's Commonwealth Scientific and Industrial Research Organization scientists placed four sampling tubes on each side of a fence enclosing four cows in a 24- by 24-yard pasture. Trace gas analyzers in a nearby trailer analyzed the air drawn through the tubes every half hour and calculated the amount of methane emitted by the cows. The first outdoor test of methane production by cattle shows that a cow grazing on pasture can emit more than 530 quarts of methane per day, mostly

through exhalation. That is more than double many estimates from indoor tests of confined animals. The studies also showed that cows fed high quality feed grain emitted 120 quarts per day, about half as much as previous tests indicated. These studies show that current climate change models used for predicting animal methane emissions do not account properly for the large effects of feed quality on methane production. According to the "indoor" estimates of the Intergovernmental Panel on Climate Change, cattle, sheep and goats together account for about a sixth of the world's total emissions of methane.

*Southern Piedmont Conservation Research Lab,  
Watkinsville, GA*

*Lowry A. Harper, (706) 769-5631*

**Chemical fertilizers and insecticides can lower populations of earthworms that are attracting new attention in sustainable agriculture practices.** Earthworms--and their burrows--aerate soil, increase water infiltration and drainage, and improve soil structure, while the worms on their own recycle nutrients from organic matter. ARS laboratory studies show that certain insecticides, mostly carbamates, are particularly toxic to worms, drastically lowering their populations. Anhydrous ammonia, a form of fertilizer, can be extremely toxic if earthworms are within two to three inches of the application point. Otherwise, it appears to have little effect on earthworms and other beneficial soil microbes. Other fertilizers and soil amendments also can have a toxic effect if they change the soil's pH.

*National Soil Tilth Lab, Ames, IA*

*Doug Karlen/Ed Berry, (515) 294-3336/9607*

**Grass rows planted as living snow fences three decades ago have given Montana wheat growers a bonus--soil-saving terraces.** Terraces break up long slopes, so that rain and snowmelt soak in instead of rushing downhill carrying topsoil. In the Midwest, growers of corn and other crops pay for earth-moving equipment to build terraces--up to several feet high. While the Montana terraces are only about a foot high, they came courtesy of Mother Nature. ARS scientists first planted perennial tall wheatgrass in rows about 50 feet apart to test how well they would trap and hold drifting snow. Amid the grass barriers, snowmelt and rainwater washed some soil downhill, building terraces over time. Over the years, planting and harvesting were parallel to the grass rows to protect the terraces.

*Northern Plains Soil and Water Research Center,  
Sidney, MT*

*J. Kristian Aase, (406) 482-2020*

**Most herbicides stay near the surface of residue-covered fields, where they are needed to kill weeds.** Only high quality rainwater goes down below the plant roots through cracks, root and worm holes, for much of the year. Thirty years of crop residue management research for erosion

control at Coshocton, Ohio, have shown that the benefits of keeping precious topsoil in place strongly outweigh the risks of groundwater contamination. On sloping land such as the fields studied, the possibility of herbicides reaching groundwater is small. When surface-applied herbicides are washed into the soil by a light rain, the chemicals are held in the top few inches of topsoil where they bind to organic matter from decomposed residue. It is only when heavy rains fall quickly after the chemicals are applied, that the chemicals move downwards. It is during these intense thunderstorms that herbicides can be flushed down soil passages that are more numerous in untilled soil, but this generally happens only in May. Herbicides are applied at corn planting time around May 1st and the surface is washed clean before the month is over. The rest of the year the water running down wormholes is often the cleanest water in the soil.

*North Appalachian Experimental Watershed,  
Coshocton, OH  
W.M. Edwards, (614) 545-6349*

**Crossing eastern gamagrass with corn** could lead to corn hybrids that provide some of their own nitrogen, reducing commercial fertilizer use, farmers' expenses and the risk of environmental contamination. Eastern gamagrass can fix nitrogen in the soil, a useful trait not found in its cousin, corn. A prairie grass, native to the Corn Belt, eastern gamagrass's roots live among microbes that capture nitrogen from the air and transfer it to the roots for plant growth. ARS scientists are investigating the two crops as a step toward breeding gamagrass's nitrogen-fixing trait into corn.

*Soil and Water Research, Columbia, MO  
Robert J. Kremer, (314) 882-6408*

**Giant six-foot-tall test tubes** filled with soil evaluate chemical pollution threats to ground and surface water. Fertilizers, pesticides, naturally occurring trace elements and heavy metals can move through the soil along with water. But early measurements allow time to find ways to prevent pollution hazards. ARS scientists have found that the test tubes are more accurate and less costly than the old-style lysimeters, which are buried in soil and cost up to 10 times more. The researchers are using four of the new devices--called weighing lysimeters--to evaluate computer models for predicting chemical movement. They also use the lysimeters to compare and validate results obtained from lab and field studies.

*U.S. Salinity Lab, Riverside, CA  
Dennis L. Corwin, (909) 369-4819*

**One big advantage of alternative farming systems** (ridge-till with rotations and organic matter inputs) over conventional farming systems may be that more rainfall infiltrates soil faster because of larger soil pores. A simulator was

used to create rainfall on two soils (Clarion loam and Webster silty clay loam) on four adjacent 40-acre fields in central Iowa. Various measurements were used to assess differences in water infiltration and the large pores in the soil (called macroporosity) caused by the two farming systems. The alternatively farmed soils were less dense than the conventionally farmed soils (1.26 vs. 1.4 grams per centimeter<sup>3</sup>). On the Webster soil, the alternative field had significantly higher infiltration (16.7 vs. 16.3 micrometers per second), greater macroporosity (6.7 vs. 4.3 percent) and less runoff (0.04 vs. 0.44  $\mu\text{m/s}$ ) in the surface layer than the conventional field. The macroporosity resulted in 15 percent more water infiltrating soil with less runoff and erosion in the surface layer. The pattern was similar for the Clarion soil but these differences were not significant. This information will be used by scientists studying soil infiltration and by extension workers advising farmers about farming systems.

*National Soil Tilth Lab, Ames, IA  
Sally Logsdon, (515) 294-8265*

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# Quarterly Report

of Selected Research Projects

July 1 to September 30, 1994

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

### Cooperative Research and Development Agreements

... With Monarch Foundation for Medical Research, Cincinnati, OH, to further simplify a computerized system for monitoring what people eat. ARS first developed the Nutrition Evaluation Scale System (NESSy) several years ago. Today, volunteers in nutrition studies enter data into NESSy at home on a notebook computer. That computer is linked to a food weighing scale to accurately log the foods that are eaten. Researchers now want to downsize NESSy to run on a smaller computer, perhaps palm-sized, so volunteers can more conveniently take the program to work or even to a restaurant. Data logged by volunteers is used by researchers to determine if participants are getting all the nutrients they need for good health. NESSy is cheaper,

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723 or 344-2824.

The report is now available in several electronic formats.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 416, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a particular company's product and/or research should be directed to the company itself.

more accurate and more efficient than the traditional approach to at-home food monitoring, in which volunteers are supposed to keep a handwritten record or daily food diary. An enhanced NESSy eventually might be used in the national food surveys that nutritionists conduct to check America's eating habits. The surveys are a key to setting U.S. Recommended Dietary Allowances for essential vitamins and minerals. (PATENT 5,233,520)

*ARS Contact: Mary J. Kretsch, Western Human Nutrition Research Center, San Francisco, CA, (415) 556-6225*

... With Resource Seeds, Inc., of Gilroy, CA, to commercially develop sweet white lupin as a high-protein, high-fiber legume crop. Lupin's variable ripening and yield often make it a tricky crop for farmers to grow. So, ARS scientists are examining the lupin plant's physical structure, sensitivity to soil temperature and other growth criteria in research aimed at improved ripening and higher yielding strains. A screening technique pinpoints lupin strains susceptible to early flowering—which reduces yield. New commercial varieties would give farmers a high-protein crop they could rotate with corn, potato, oat and other crops grown in states too cool for soybeans, such as Minnesota. Dairy farmers in northern states could grow lupin as an excellent protein for cattle in place of soybean, which farmers otherwise may have to buy. Lupin also offers high-fiber flour for consumer use in cereals, cake mixes, pastas, breads and other baked goods.

*ARS Contact: William Clapham, New England Plant, Soil and Water Lab, Orono, ME, (207) 581-3266*

... With Northrup King of Stanton, MN, to evaluate corn hybrids that the company's scientists bioengineered to resist two leaf-eating pests of southern corn—the fall armyworm and southwestern corn borer. The test corn is known as "transgenic" because its new gene comes from a different organism, the bacterium *Bacillus thuringiensis*, or Bt. In natural Bt—and the engineered corn—the gene makes a protein that kills borers, armyworms and other caterpillar pests. In lab and field studies, ARS scientists are comparing damage from the two pests in the transgenic corn against that in susceptible commercial varieties and corn hybrids conventionally bred for pest resistance. Bt commercial sprays and powders have been sold for many years. Uncontrolled, borers can reduce yields up to 40 percent; armyworms can cause total yield loss.

*ARS Contact: W. Paul Williams, Corn Host Plant Resistance Research, Starkville, MS, (601) 325-2735*



... With Quest International of Sarasota, FL, to produce special dextrans for food processing and industrial applications. Dextrans are natural sugars produced by *Leuconostoc* bacteria. They have the potential to replace costly plant gums as binding agents, emulsifiers and stabilizers in processed foods and in industrial products such as writing ink. One type of dextran is currently used in pharmaceuticals. ARS scientists are breeding several strains of the bacteria to isolate new dextrans. Quest will then evaluate their commercial potential. One promising candidate may be used as an artificial, low-calorie sweetener.

ARS Contact: Michael R. Smith, Process Biotechnology Research, Albany, CA, (510) 559-5865

... With Cytec Industries, Inc. of Stamford, CT, for improving use of polyacrylamides (PAMs) to halt irrigation-related erosion. Adding small amounts of the inexpensive white powder to irrigation water helps anchor soil particles that can wash away as irrigation water moves down furrows. In preliminary experiments, PAM reduced erosion by up to 99 percent and boosted infiltration of irrigation water an average of 15 percent. Cooperative research will produce simple and more efficient ways to use the powder, a synthetic chemical called a polymer, to thwart erosion that threatens some 600 million acres of irrigated cropland worldwide. Test results will help researchers determine proper amounts of PAM to use on various soils. Cytec currently markets PAM for cleaning water in municipal treatment plants.

ARS contact: Robert E. Sojka, Soil and Water Management Research, Kimberly, ID, (208) 423-6562

## Biological Control

North American parasitic wasps that kill crop-eating whiteflies will be available as specimens on long-term loan to various laboratories conducting quarantine, rearing or field releases of the wasps. Whiteflies (*Bemisia tabaci*) can resist pesticides, so natural enemies are likely alternatives. ARS scientists prepared specimen slides of 20 species of the parasitic wasp (*Encarsia*) and are completing pictorial keys. All the information eventually will go into computer databases on the wasp worldwide, to be used by researchers investigating whitefly control.

Systematic Entomology Lab, Washington, DC  
Mike Schauff, (202) 382-1784

A fuzzy, half-inch-long fly imported from South Korea could soon be turned loose on gypsy moths in the United States. A five-year ARS study ranked the fly, *Blepharipa schineri*, as the third most successful gypsy moth parasite in South Korean forests. The moth's top two parasites there—

a *Cotesia* wasp and a *Parasetigena* fly—have already been imported and released in this country. Now, offspring of *B. schineri* flies that ARS scientists collected in South Korea and Germany are being reared at an agency lab in Delaware. With federal and state approvals, the flies could be released in American forests as early as 1995. When chewing on leaves, a hungry gypsy moth caterpillar can accidentally swallow the fly's eggs. Maggots that hatch from the eggs feed on the pupae—the last stage before adulthood—slowly killing them. Gypsy moths infest 16 northeastern states, feeding on leaves of hundreds of kinds of trees and shrubs.

Beneficial Insects Introduction Research, Newark, DE  
Roger W. Fuester, (302) 731-7330

Aquatic Weed Control Research, Fort Lauderdale, FL  
Robert W. Pemberton, (305) 475-0541

European Biological Control Lab, Montpellier, France  
Franck Hérard, 33-67-04-56-00

A microscopic organism that attacks mosquitoes spreading yellow fever is being tested in Florida field studies. They're the first outdoor tests in the United States of a foreign microorganism to control *Aedes aegypti* mosquitoes. This species breeds in water-catching places such as abandoned tires and clogged gutters throughout the southeastern states. *A. aegypti* spreads yellow fever and dengue, viral diseases that are not currently found in the United States but have the potential to spread here from other parts of the world. A microsporidium, *Edhazardia aedis*, infects the mosquitoes with tiny spores that eventually weaken or kill the insect. Female mosquitoes that survive spread the microsporidium to the next generation through their eggs. In lab tests, *E. aedis* has had no long-term, adverse effects on animals or beneficial insects such as honey bees. *A. aegypti* is now controlled by removing standing-water containers where females lay eggs, but often that approach isn't practical. And the pest has developed resistance to insecticides. If the biocontrol field tests are successful over the next few years, the microsporidium could be developed commercially as a natural way to control *A. aegypti*.

Medical and Veterinary Entomology Research Lab,  
Gainesville, FL

James J. Becnel, (904) 374-5961

A little too much perfume makes a male moth's life miserable. Normally, male diamondback moths welcome the female's sex scent, called a pheromone. That chemical scent helps the males find females ready to mate. To interrupt reproduction, ARS scientists are flooding crop fields in Florida with the synthetic female pheromone. Males become confused, unable to pick up a female's scent. It's part of a three-pronged approach for controlling diamondback moths and other crop pests without using chemicals. Other tactics include parasitic wasps that attack moth larvae, and Bt insecticide that kills surviving larvae without damaging the beneficial wasps. In field tests,



scientists found that in scent-laden fields only 36 percent of female moths had mated, compared to 86 percent in conventional fields. That meant pesticide sprayings were reduced from 15 to three on the fields where pheromones were used.

*Insect Attractants, Behavior and Basic Biology  
Research Lab, Gainesville, FL  
Everett Mitchell, (904) 374-5710*

## New and Improved Products

An ARS recipe using rice flour for making bread has been newly adapted to home breadbaking machines. ARS scientists developed a recipe some 20 years ago for people with celiac disease, a wheat allergy. Now the researchers have revised the recipe to give the home baker a new choice among rice breads they can make with the countertop appliance. The machine automatically mixes, kneads and bakes the rice-flour dough, but must be assisted after the kneading cycle. The recipe calls for methyl cellulose, a food processing ingredient. Methyl cellulose traps bubbles given off by yeast, making the dough rise and giving the bread its light texture. The recipe also requires short- or medium-grain white or brown rice, sold at health food stores and Asian grocery markets. Home bakers can modify the flavor by substituting honey or brown sugar for table sugar, or by adding small amounts of spices, fruits or nuts.

*Cereal Product Utilization Research, Albany, CA  
Maura Bean, (510) 559-5660*

A new fiber optics probe was 95-percent accurate in identifying diseased and improperly bled chicken carcasses at processing plants. Light beams from the probe reflect off carcasses, with the problem ones sending back light spectra that can be analyzed and singled out instantly. The problem chickens either had a disease called septicemia or were improperly bled. These two problems account for over half of the carcasses removed from chicken processing lines by inspectors. Abnormal chickens were identified by a computer program that recognizes differences in reflectance spectra of returning visible and invisible light. The probe is held less than an inch from the carcass to send and receive light. An automated system using such a probe on processing lines would remove carcasses before reaching inspectors.

*Instrumentation and Sensing Lab, Beltsville, MD  
Yud-Ren Chen, (301) 504-8450*

Until now, consumers have had difficulty getting a frozen sweetpotato, after being thawed and baked, to taste like a fresh sweetpotato just taken from the oven. Now, ARS scientists have made it possible for consumers to enjoy the flavor and texture of this high-beta-carotene food, as well as other types of vegetables, without cooking them for a long time. Scientists added a binding agent and sugar to sweetpotato puree before freezing. When thawed and baked for 15 minutes, the new product's texture and taste were rated excellent. An important advantage of using the binder, a cellulose derivative, is that it works for all grades of sweetpotatoes, allowing the entire crop to be used for processing.

*Food Science Research, Raleigh, NC  
William M. Walter, (919) 515-2990*

Eastern gamagrass, a cousin to corn, could lead to genetically modified corn oil that's more healthful or stays fresh longer. ARS scientists analyzing oils from 23 eastern gamagrass strains frequently found lower levels of saturated fat than those typically present in corn, soybean and olive oil. The gamagrass oils also generally contained extremely low levels of linolenic acid—less than one percent. Food oils high in linolenic acid are prone to quickly develop off-flavors unless deterred by a commercial process called hydrogenation. Breeding genes from gamagrass into corn could improve corn oil's healthfulness and shelf life.

*Range and Pasture Research, Woodward, OK  
Bryan K. Kindiger, (405) 256-7449*

A new, air-filtration system for commercial insectaries could reduce allergic responses of workers to insect debris. As they are maintained at rearing facilities, moths and other beneficial insects like parasitic wasps constantly shed tiny scales and other body parts. When this material becomes airborne, it can trigger sneezing, asthma, runny noses and other symptoms. To alleviate the problem, ARS scientists and collaborators developed the new filter system as a prime component of standard sanitary procedures. These include mopping, vacuuming and use of special facilities to house debris-shedding insects. In laboratory tests near 22,000 caged moths, the filtration system removed over 95 percent of insect scales and other particles from the surrounding air. The system is comprised of a series of ducts and filters that run behind mesh cages used to contain insects. Several U.S. public and private firms have expressed interest in adapting ARS' technology to their insect-rearing facilities.

*Crop Science Research Lab, Starkville, MS  
Johnie Jenkins/Frank Davis, (601) 323-2230*

## Human Nutrition

Deficiencies in either of two antioxidant nutrients turned a normally mild-mannered virus into a disease-causing strain in mice. This finding demonstrates the important role of nutrition in the severity of viral infection. Selenium-deficient mice were inoculated with the benign B3 strain of Coxsackie virus. That strain is a close relative to the B4 strain, which was isolated from Chinese people with Keshan disease—heart-muscle damage once common in China's Keshan region where the soils lack selenium. To the researchers' surprise, the mice developed similar heart-muscle damage from the B3 strain. What's more, when the virus from selenium-deficient mice was inoculated into animals that got ample selenium, it again caused heart-muscle damage. Scientists concluded that the benign B3 strain had mutated into a virulent strain while residing in the selenium-deficient animals. Similar results occurred with vitamin E-deficient mice. Possibly, this Dr. Jekyll to Mr. Hyde transformation happens in other viruses in animals or humans with poor antioxidant status. Other researchers have suggested that this condition may influence influenza, hepatitis or HIV infections.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*Orville A. Levander, (301) 504-8504*

*University of North Carolina, Chapel Hill*

*Melinda A. Beck, (919) 966-6809*

Very-low-birth-weight infants taking mother's milk through a tube in their stomachs gain weight faster when given only the portion of the milk produced two to three minutes after the flow begins. That's according to a study of 15 preemies ranging from a little more than one pound to nearly five pounds at birth. This hindmilk, as it is called, is richer in fat than the initial flow and offers a concentrated source of calories. As a result, the preemies gained an average 1/4 ounce more each day than when fed regular breastmilk. That weight is closer to what they would have gained had they still been in the uterus. Very low-birth-weight infants often have difficulty gaining weight on breastmilk and are switched to formula. But they lose the substances in breastmilk that appear to protect them against potentially life-threatening infections. So researchers are looking for ways to approximate fetal development with mother's milk.

*Children's Nutrition Research Center, Houston, TX*

*Richard J. Schanler, (713) 798-7000*

*Baylor College of Medicine, Houston, TX*

*Christina J. Valentine, (713) 770-1380*

The hope that people might develop fewer cancers and other diseases of aging by severely limiting calories after age 50 got little support in a new study of rats. Slashing the calorie intake of middle-aged rats did not increase their life span. That finding is in sharp contrast to hundreds of studies on young animals done in other laboratories over several decades. Young rats lived 30 to 40 percent longer when their calorie intake was 2/3 or less of what they would normally eat. Nutrition researchers theorize that lifelong calorie restriction cuts the number of tumors—the primary cause of death in test rats—by lowering the rate of cell growth. Also, fewer calories may reduce kidney disease. In the new study, however, male rats ate as much as they wanted for their first 18 months—equivalent to the first 50 years for a man. Then they got 33 percent less food for the rest of their lives, with little or no effect on life span. Apparently certain disease processes have already begun by this age, too late to be helped by calorie cutting.

*USDA Human Nutrition Research Center on Aging at  
Tufts, Boston, MA*

*Ruth D. Lipman, (617) 556-3204*

Copper deficiency in test animals causes symptoms that resemble those of human diabetes and aging, and new findings shed light on why. They support the hypothesis that copper deficiency increases the spontaneous attachment of glucose molecules to proteins, known as protein glycation. Left unchecked, the dangling glucose molecules attach to a second site on the protein, producing "cross links." This prevents proteins from functioning because they can't change shape to fit into specific receptor sites like puzzle pieces fit into only one spot. Protein glycation is known to increase in all people as they age and to cause tissue damage in diabetics. To test the hypothesis that copper deficiency promotes the process, an ARS researcher administered daily doses of the drug aminoguanidine to half of a group of copper-deficient rats. The drug does not block the initial attachment of glucose but prevents the formation of cross links. At the end of the study, treated rats had less of the anemia and heart damage characteristic of copper deficiency, whereas untreated rats died prematurely from these conditions.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND*

*Jack T. Saari, (701) 795-8499*

Slim and trim adult rats that were put on a yo-yo diet had three to four percent more body fat than control animals kept on a steady calorie intake. These findings suggest that weight cycling—gaining, losing and regaining—could tip the scale in favor of fat accumulating in the body, at least for a while. Animals and people appear to



adapt to a reduction in calories by storing more fat in times of plenty to prepare for the next deficit. A three- to four-percent increase in fat is not much for people of normal weight. But, it can be quite significant for obese people who often have much larger weight swings than the study rats. Because rats normally keep growing throughout life if allowed to eat all they want, the researchers limited growth of the test animals prior to the study, so it would more nearly approximate that of adult humans. Then, they put one group of rats through three weight cycles, in which they gained 10 percent above starting weight, lost 10 percent below, then returned to starting weight. The other group remained on the growth-restricting diet. Both groups had the same energy intake and expenditure at the end of each cycle.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*Paul W. Moe/Eugene R. Wiley, (301) 504-8988/504-8978*

**Several large feedings, rather than continuous feeding,** may promote the maturing of the intestinal tracts of very premature infants and full-term babies who need to be fed through a tube for extended periods. A preliminary study of piglets found that the group that got four "milk meals" through a tube into the stomach had significantly more intestinal growth and greater amounts of some digestive enzymes than those fed continuously. Piglets were tested because their digestive system closely resembles that of humans. Researchers were looking for ways to encourage the intestinal tract to develop as naturally as possible in situations like tube feeding. Normally, the small intestine undergoes dramatic growth and development of its digestive capability after birth, particularly in preterm infants. And the enzyme that digests the primary milk sugar, lactose, increases the most during the last trimester of pregnancy. Researchers are now testing these two feeding regimens in 80 low-birth-weight infants and, at the same time, determining the optimal time to begin feeding—three to four days after birth versus seven to 10 days.

*Children's Nutrition Research Center, Houston, TX  
Robert Shulman, (713) 798-7145*

**Do supplements of fat-soluble vitamins compete with one another in the intestinal tract for absorption,** as some reports suggest? No, according to studies using ferrets as a model. Researchers found that a dose of vitamin E equivalent to the Recommended Dietary Allowance (RDA) for humans actually enhanced beta carotene uptake fourfold. Raising the vitamin E dose to 20 times the RDA increased beta carotene uptake 14 to 19 fold. Vitamin E also increased the conversion of beta carotene into vitamin A in line with the amount of vitamin E taken. A dose of beta carotene, on the other hand, didn't enhance vitamin E uptake. But it didn't block it either. If people respond as the ferrets did, vitamin E supplements may be used to improve beta carotene and

vitamin A status when ingested together. Both nutrients are important antioxidants. Vitamin E supplements have been associated with a lower rate of heart disease. And a high beta carotene intake has been linked to reduced risk of several cancers.

*USDA Human Nutrition Research Center on Aging  
at Tufts, Boston, MA*

*Xiang-Dong Wang, (617) 556-3130*

**The alcohol in a drink or two can't be ignored in a weight-loss regimen.** A study of 48 men and women confirmed that alcohol does not rev up the body's metabolism to detoxify and dispose of it, providing no net calories as some reports have suggested. Measurements of the volunteers' energy balance support the premise that alcohol contributes seven calories per gram—at least for moderate drinkers. That puts it halfway between fat (nine) and carbohydrate (four) for caloric density. The study also found that people burn alcohol calories only as efficiently as they burn carbohydrate or fat calories. During half of the 16-week study, the volunteers were given the equivalent of two alcoholic drinks per day, accounting for five percent of their total calorie intake. During the other half they got the same beverage without alcohol. Researchers measured the calories burned by each volunteer over 24 hours. So moderate drinkers can count on 70 to 90 alcohol calories for each four-ounce glass of wine, can of beer or jigger of liquor. And that doesn't include carbohydrate calories in the drink.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*William V. Rumpler, (301) 504-8360*

## Scientific Information Systems

**Snowflakes can be magnified 10,000 to 20,000 times** to improve forecasts of how much water will be released by melting mountain snowpacks in the spring. Snow melt provides as much as 90 percent of the water supplies in western states like California. Computer models now forecast how much of the snow melt will likely be available to farmers for summertime irrigation. The ARS snowflake images could improve snowpack data that's collected by remote-sensing satellites for the models. That's possible since the magnifications enable more precise calculations of snowflakes' size and structure. Standard snow-sampling techniques don't fully characterize these features. To produce the images, scientists dip snowflakes in liquid nitrogen at -320 degrees F, coat them in platinum and zap them with an electron beam for imaging by the scanning electron microscope.

*Scanning Electron Microscopy Lab, Beltsville, MD  
William Wergin, (301) 504-9027*



Harvesting hay in round bales up to six feet in diameter is popular among dairy farmers, but storing these large bales indoors to protect them from adverse Midwest weather could cost more than it's worth. That's if the hay is only a minor part of the herd's feed, according to DAFOSYM, an ARS-developed computer model that simulates dairy farm operations. DAFOSYM studies found that storage costs may exceed costs related to damaged hay—lost milk production potential and purchase of extra feed. However, the model showed that storing smaller bales—about four feet in diameter—under cover usually makes good economic sense because loss from these bales would be much greater when they have no protection from the weather. Capital expenses for storing larger six-foot bales is justified if hay, rather than silage, comprises a major part of the cattle's forage.

*U.S. Dairy Forage Research/Fruit and Vegetable Harvesting Research, East Lansing, MI*  
C. Alan Rotz, (517) 353-1758

## Animal Production and Protection

Cottonseed, a popular ingredient in cattle and sheep feed, could pose a problem for beef producers raising breeding bulls. Cottonseed meal and whole cottonseed contain varying levels of gossypol, reportedly linked to infertility in human males and testicular tissue damage in mature bulls and rams. In field tests, scientists with ARS and the Texas Agricultural Experiment Station at Overton fed young bulls diets containing either cottonseed meal, whole cottonseed or soybean meal for 196 days from weaning through puberty. At the end of the feeding trial, microscopic examination of testicular tissue indicated germ cells responsible for spermatozoa production were damaged in bulls fed cottonseed meal or whole cottonseed. Other findings: Bulls that ate cottonseed meal weighed more, reached puberty and tended to have spermatozoa at an earlier age than bulls fed whole cottonseed. Diet did not appear to affect testicular size or weight, but the findings on spermatozoa germ cell damage suggest beef producers may want to reconsider diets for young bulls in the herd.

*Subtropical Agricultural Research Station,  
Brooksville, FL*  
Chad C. Chase, Jr., (904) 796-3385

A 25-million-year-old fruit fly will give new clues to accurately classifying modern species of the family *Tephritidae*—including pests like Mediterranean fruit flies. Such accuracy is critical to understanding the evolution and distribution of current and new insect pests and to developing strategies to control the pests. ARS scientists analyzed the extinct fruit fly species, well-preserved in amber from the Dominican Republic, and found it is related to a new fruit fly

genus from Brazil and two from Asia. Since no living fly species from the genus is from North America, the researchers believe it evolved in the New World tropics.

*Systematic Entomology Lab, Washington, DC*  
Allen Norrbom, (202) 382-1795

A test for malignant catarrhal fever (MCF), a herpesvirus disease often fatal as it spreads among cattle, should be available soon. ARS scientists recently developed the first reliable test to detect infected cattle using monoclonal antibodies. Losses caused by MCF are unknown because no reliable diagnostic test is available. Bison and deer can also get MCF. Sheep carry the virus but do not show signs of the disease. ARS scientists are developing a gene-based test to study transmission of the virus at the molecular level. They hope the studies will unravel the mystery of how the MCF herpesvirus spreads from one animal to another.

*Animal Diseases Research, Pullman, WA*  
David Shen, (509) 335-6002

Blood-feeding stable flies may find cattle feedlots a less hospitable home if pyriproxyfen comes to call. Not yet commercially available in the United States, pyriproxyfen is an insect growth regulator (IGR), a type of pesticide that's not toxic to mammals. IGRs can be mixed with cattle's feed for subsequent excretion in dung where pesky stable flies like to breed and lay eggs. ARS researchers found 12 parts per billion (ppb) of pyriproxyfen killed 50 percent of flies when mixed with fly larvae diets. Only 2.6 ppb were needed to cut the fly population in half when applied directly to larvae. Tests also showed adult flies absorb external doses of pyriproxyfen very rapidly, but their bodies are slow to break down and excrete the material—excellent attributes for a pesticide. Pyriproxyfen stands up well to environmental stress and could be an effective treatment of stable fly breeding sites, either applied indirectly through contaminated dung or by spraying it on accumulations of animal waste.

*Food Animal Protection Research, College Station, TX*  
Don L. Bull, (409) 260-9401

For the first time, the number of parasites that ticks transmit to cattle can be directly measured using a new tick-feeding chamber. ARS scientists use the chamber along with high-tech genetic probes to accelerate the scientific war on anaplasmosis and babesiosis, livestock diseases caused by tick-borne parasites that inhabit the blood of animals. Key to the chamber, designed by Kenyan researcher Samuel Waladde, is a membrane derived from cow intestines. The membrane mimics the skin surface of a cow, so the finicky ticks are duped into feeding as if a real animal were present. Until now, such disease studies required using live animals as hosts for the biting ticks. With DNA probes, researchers can determine which and



how many parasites are in the blood, and the number of parasites a tick must take up to become infected. Then, by serving "clean" blood in the chamber, researchers can estimate how many parasites the infected ticks could pass to the bloodstream of each host. This system helps scientists identify which of the many kinds of ticks are important in spreading diseases. The chamber may also aid studies of other tick-borne diseases of domestic animals, wildlife or humans—including Lyme disease and Rocky Mountain spotted fever.

*Animal Diseases Research, Moscow, ID*  
*David Stiller/Michael Coan, (208) 885-7081*

## Crop Production and Protection

**Apple buds placed in a deep freeze** were stored without damaging their genetic structure. In a pilot research project, ARS scientists will continue to store buds in this form of "suspended animation" for 20 more years to confirm that it's an effective, safe way to preserve apple genes from current and old, rare varieties. One main advantage of deep-freeze storage: at least a 10-fold savings in maintenance costs, because live trees don't have to be cared for on a year-round basis. Buds from 64 apple varieties have been stored in liquid nitrogen (LN) at -196 degrees C for five years at the National Seed Storage Lab in Fort Collins, CO. The buds have been periodically removed from LN and grafted onto rootstock. Buds from all 64 varieties came back to life. And for 90 percent of the varieties, at least half the buds produced healthy trees. In addition, researchers have placed in LN buds from 250 other apple accessions—10 percent of the current collection. The eventual goal is to back up the entire collection in LN storage, allowing curators to remove about half the apple trees from the field.

*Plant Genetic Resources, Geneva, NY*  
*Philip L. Forsline, (315) 787-2390*

**A 77-year-old mistake about a wheat fungus** in California was corrected by an ARS scientist, opening the state's trade door of wheat to China. The Chinese government imposed a zero-tolerance level for spores of the fungus, which kept the door shut on California wheat. That fungus, *Tilletia controversa*, causes dwarf bunt disease—not known to occur in China. China's quarantine could be traced, in part, to a USDA employee's report in 1917 that he had collected the fungus in California. Now, an ARS researcher has uncovered evidence, including a specimen from the U.S. National Fungus Collection and documents at the National Archives, that shows the collector erred. The culprit specimen came from Oregon. Based on this finding, China lifted its

quarantine on wheat from California, which produces 1.3 million metric tons a year. Last year, China bought about three million metric tons of wheat grown in the Midwest.

*Systematic Botany and Mycology Lab, Beltsville, MD*  
*Amy Rossman, (301) 504-5364*

**New potato breeding lines that resist late blight disease** could be released to plant breeders within two years. Late blight can destroy a potato crop in the field or in storage in just a few weeks. It's the disease that caused the potato famine that led to the mass exodus from Ireland in the 1840s. It is caused by *Phytophthora infestans*, a fungus that has become resistant to the main group of chemicals used to control it. Using biotechnology and classical breeding methods, ARS researchers crossed a wild potato species with a cultivated variety to produce new fertile, blight-resistant lines. ARS researchers and collaborators found a new, more aggressive strain of the fungus—also fungicide resistant—in the Pacific Northwest, California, Florida, Maine, Michigan, North Carolina, Pennsylvania, Texas and Wisconsin. The new genetically engineered breeding lines are as resistant to these new strains of the fungus as their wild relatives. A goal is to see if the lines produced by classical breeding resist these new strains.

*Disease Resistance Lab, Madison, WI*  
*John P. Helgeson, (608) 264-5276*  
*Vegetable Lab, Beltsville, MD*  
*Kenneth Deahl/Robert Goth/Kathleen Haynes,*  
*(301) 504-7380*

**Eastern gamagrass, a forage crop for livestock**, also could provide a nutty-tasting, high-protein grain for humans. ARS researchers have found a nutritious grain for consumers is possible in the future, using sophisticated breeding techniques. Eastern gamagrass plants that have multiple copies of a naturally occurring, mutant gene can produce up to 20 times more kernels—enough to inspire further research on yield and other agronomic traits needed for developing a dual-purpose grain and forage crop. Gamagrass plants bearing the mutant genes, gynodioecious sex form-1, produce more seed because male portions of their flowers are "feminized." Scientists developed a quick test that pinpoints the extra-gene seedlings within days. Next comes research to combine the gynodioecious trait with other valuable traits. Then, by including another trait called apomixis, the scientists hope to lock in the desired genetic "grain package" for succeeding generations. Apomixis is the ability to reproduce asexually through seed. It means undesired traits cannot be accidentally introduced in offspring by fertilization with another plant "parent."

*Range and Pasture Research, Woodward, OK*  
*C. Ann Blakey, (314) 882-8214*



Enzymes discovered in oranges and grapefruits could help citrus and other crops defend themselves against diseases, insect pests and harmful nematodes. ARS researchers found the potential defense in more than 20 different forms of enzymes, called chitinases and chitosanases. Although the role of these enzymes in citrus is not fully understood, scientists think they may help protect against pests. In crop-damaging culprits, the enzymes could break down chitin, the toughener in insect exoskeletons and cell walls of many fungi. The next step: identifying genes responsible for producing chitinase and chitosanase in citrus. Putting these genes into plants that don't have them—and manipulating them in plants that do—would give crops natural weapons against attackers.

*U.S. Horticultural Research Lab, Orlando, FL*  
*Richard T. Mayer, (407) 897-7304*

**Soft red winter wheat will have new resistance** to the Hessian fly, *Mayetiola destructor*, the grain's most damaging pest. One Hessian fly strain, designated biotype 'L', has adapted genetically to survive on current resistant soft wheat cultivars, thus reducing their ability to resist its attack. Now, scientists with ARS, Purdue University and the University of Florida have cooperated in screening, developing and testing five new resistant germplasm lines for breeders to use in developing improved wheat cultivars adapted to the eastern and southern states. Recently, the Hessian fly has been especially damaging to southeastern wheat crops. That region's warmer climate allows up to six generations of flies to breed per year. In Georgia, damage from the pest was estimated at \$28 million in one season. Hessian fly-resistant, soft red winter wheat seed is available from ARS researchers at West Lafayette, IN.

*Insect and Weed Control Research, West Lafayette, IN*  
*Roger Ratcliffe, (317) 494-4606*

**Alfalfa that wards off two of its major pests** better than commercial varieties is now available to plant breeders. ARS and Washington State University scientists jointly developed, tested and released the new alfalfa germplasm known as W12SR<sub>2</sub>W<sub>1</sub>Fu<sub>1</sub>. It resists root-knot and stem nematodes better than the commercial varieties. It's also a good source of resistance to bacterial, *Fusarium* and *Verticillium* wilts. These diseases and nematodes cost growers several million dollars in yield loss every year. It should be especially useful in combining pest resistance with valuable traits already in existing commercial varieties, like high yield and resistance to drought and insects.

*Irrigated Agriculture Research and Extension Center, Prosser, WA*

*Richard N. Peaden, (509) 786-3454*

**A new, high-yielding sugarcane** armed with insect and disease resistance is now available to growers. Scientists at ARS, Louisiana State University and the American Sugarcane League of the USA, Inc., cooperatively developed LCP 86-454 from a selection of more than 150,000 seedlings for high sucrose content and yield, plus easy harvesting and resistance to diseases including smut and leaf scald. In seven years of testing, sucrose yield of LCP 86-454 equalled that of two leading commercial varieties, CP 65-357 and CP 70-321. Another plus: The new variety withstands infestations by sugarcane borers, insects that tunnel through the stalks and sometimes reduce sucrose yield up to 15 percent. Also, the sturdy stalks of LCP 86-454 stand up to crop-flattening winds and don't break upon mechanical harvesting. Growers can get seedcane through the American Sugarcane League of the USA, Inc., Thibodaux, LA.

*Sugarcane Research, Houma, LA*

*Benjamin L. Legendre, (504) 872-5042*

**A hybrid wheat plant that disappointed plant breeders** decades ago now looks promising as a forage to fill early-summer, cattle grazing gaps from Kansas to Texas. Agroticum, the hybrid, was developed in the 1930s from a cross of common wheat, an annual plant, and perennial tall wheatgrass, but it failed to provide the dreamed-of perennial wheat. A new offspring called OK906—a cross of agroticum and another wheat—offers good quality grazing from mid-November to late spring. In two years of field trials in Oklahoma, agroticum provided 26 to 56 more days of grazing than winter wheat, a popular cool-season forage choice. Forage quality and protein levels of OK906 are comparable to winter wheat. It offers a good pasture well into June, when warm-season grasses become available, while winter wheat grazing in the Southern Plains is usually gone by mid-May. OK906 will be jointly released by ARS and Oklahoma State University, and seed should be available to farmers by mid-1995.

*Grazinglands Research, El Reno, OK*

*Jerry D. Volesky, (405) 262-5291*

**Insect pathogens are the latest weapons** against the citrus leafminer, a new pest eating its way through Florida's citrus groves. Leafminers, which appeared in May 1993, have spread rapidly throughout Florida and have become a threat to citrus groves and nurseries. Among the environmentally friendly pathogens deployed against the leafminer:

*Paecilomyces* fungi, *Bacillus thuringiensis* bacteria, a nuclear polyhedrosis virus and *Steinernema carpocapsae* nematodes. The pathogens being used won't attack any beneficial insects and will harm only their target pest.

*U.S. Horticultural Research Lab, Orlando, FL*

*Jeffrey P. Shaprio/William J. Schroeder, (407) 897-7300*



**Apples suited to Appalachian weather** and a nectarine for the Southeast will appear at roadside stands and markets within the next year. Early Thompson, an early-season eating apple, adapts well to pick-your-own operations in the southern Appalachian Mountains. Another new eating apple, Hardy Cumberland, withstands the unpredictable spring temperatures of the Appalachians. It yields a fall or early winter harvest. ARS released the apples jointly with the University of Tennessee. Sunsplash, a new nectarine, is one of the first to be harvested in south Georgia. It shows moderately high resistance to bacterial spot, a major disease of nectarines in the Southeast. ARS is releasing the nectarine in cooperation with the University of Georgia and the University of Florida Agricultural Experiment Station.

*Southeastern Fruit and Tree Nut Research Lab,  
Byron, GA*

*Ann Amis/Tom Beckman, (912) 956-5656*

**A new line of white clover** has been released for breeding commercial varieties that resist some of the most harmful nematodes attacking this forage crop. In warm weather, the microscopic, soil-borne worms often stunt the growth of white clover, grown primarily in the North and Southeast as a high-protein cattle forage. Greenhouse tests showed the new line, MSNR4, was nearly 100 percent resistant to three nematode species—southern root-knot, peanut root-knot and rice root-knot. It also offered some resistance to northern root-knot nematodes. Scientists with ARS and the Mississippi Agricultural Experiment and Forestry Station developed the MSNR4 breeding line. They now are working to bolster seed production and the clover's ability to regrow after frequent grazing by cattle.

*Crop Science Research Lab, Mississippi State, MS  
Gary A. Pederson/Gary L. Windham, (601) 323-2230*

**Black Emerald, a new seedless grape**, is ready to harvest in mid-May when no other top-quality, U.S.-grown, black seedless grape is on the market. ARS researchers made Black Emerald available to growers this spring after seven years of tests. In the next three to five years, growers may plant enough vines to market the grapes nationally. Black Emerald's sweet, juicy grapes are about the size of a dime. The flesh is translucent and firm—almost crisp. Nurseries and breeders can buy cuttings or young vines from the Foundation Plant Materials Service of the University of California at Davis. Growers funded part of the research through the California Table Grape Commission.

*Horticultural Crops Research Lab, Fresno, CA  
David W. Ramming/Ronald Tarailo, (209) 453-3160*

**A sequence of three genes** has been located on a single chromosome in a fungus that produces aflatoxin—opening further the possibility of tailoring a fungus unable to make the toxin. Aflatoxins accumulate in plant tissues of corn, cottonseed and peanuts in hot, dry weather; infected crops cannot be used as feed for livestock. ARS scientists mapped the three genes side by side while studying chromosomes of the aflatoxin-producing *Aspergillus parasiticus*. Now, the goal is to learn how these genes work and how they're naturally regulated. New breeds of plants could then be selected that minimize the genes' activity, or a fungus could be created that doesn't produce aflatoxin and ideally could out-compete toxin-producing strains.

*Commodity Safety Research Lab, New Orleans, LA  
Maureen Wright, (504) 286-4294*

**Next spring, growers will be able to plant Windsor cicer milkvetch**, which outyields by up to 20 percent the most productive variety of this forage legume now available. Windsor, developed by ARS scientists, will supply as much forage as alfalfa, its more familiar cousin. It is more productive because the plant ignores nature's command to slow down and conserve energy as summer days get shorter. Seed is available from Peterson Seed Company of Savage, MN. ARS released Windsor in cooperation with the Colorado and Wyoming agricultural experiment stations. It's well adapted to those states in pastures for cattle, sheep, goats and horses. Tests at nearly 20 locations are determining its suitability for the Midwest, other areas of the United States, western Canada, western Europe and New Zealand.

*Rangeland Resources Research, Fort Collins, CO  
Charley E. Townsend, (303) 498-4231*

**Western winter wheat farmers who switch to corn, sorghum or sunflower** for a couple of years can stifle jointed goatgrass. ARS scientists have demonstrated that growing two of these crops in a row, after the traditional two-year, fallow-wheat growing cycle, can reduce the number of goatgrass weed seeds in fields by up to 90 percent. This weed, now infesting about 3.5 million acres, has become a major problem in western wheat fields since 1980. Besides reducing wheat yield, goatgrass produces seeds that get harvested along with grain. That lowers the flour's quality and limits wheat export opportunities. Farmers can't use commercial herbicides to control goatgrass in wheat fields, because the chemicals also kill wheat plants.

*Central Great Plains Research Station, Akron, CO  
Randy L. Anderson, (303) 345-2259*

## Soil, Water and Air Quality

A new computer-based predictor of wind erosion will be used by USDA's Soil Conservation Service to develop conservation plans for farmers with highly erodible land. Federal assistance to these farmers depends on having a conservation plan in place by the end of this year. ARS scientists developed the revised wind erosion equation (RWEQ) to replace the original equation in use since 1965. One of a new generation of computer models, RWEQ simulates weather and erosion for localized predictions anywhere in the world for periods of one to 15 days. With the old equation, average annual calculations were verified from a limited number of past observations of research plots and climate data of the central Great Plains.

*Wind Erosion Research, Big Spring, TX  
Donald Fryrear, (915) 263-0293*

Sound waves bouncing off the sand-covered bottom of a 100-foot long plexiglass trough will provide new insights into how to protect streambeds from filling up with sediment, which may cause flooding, erosion or collapse of the stream banks. One key part of the solution is to accurately measure the rate of sediment movement along the stream bottom. Such information is critical for developing stable channels in agricultural watersheds. That's what researchers from ARS and the University of Mississippi's National Center for Physical Acoustics have joined forces to do. University researchers developed a sonar device called a SedBed Monitor to track the location of the sediment bottom in streams. ARS scientists used the plexiglass trough to simulate a stream and developed the techniques to use the device to measure the rate of sediment movement. Sound that bounces off sediment moving along the bottom is picked up by a microphone and fed into a computer. Within minutes, the computer can display or print out a graphic image of the changing topography of the streambed, which is used to calculate the rate of sediment movement in a channel. This method takes much less time than conventional sampling.

*USDA National Sedimentation Lab, Oxford, MS  
Roger Kuhnle, (601) 232-2971*

How rainwater and chemicals move through soil is influenced more by compaction from farm tractor tires than by tillage. Both these factors change the size of pores in and the structure of agricultural soils and can make a big difference in the quality of drinking water. Because many farmers have shifted to no-till cultivation to minimize soil erosion under the 1990 Food Security Act, the differences between water-movement patterns on no-till fields versus conventional-till cornfields needs to be understood. ARS scientists compared water infiltration rates in trafficked and

untrafficked parts of fields on five soils at locations in Iowa, Minnesota, Missouri, Nebraska and Wisconsin. Wheel traffic reduced infiltration rates for both tillage systems at all locations, from more than 95 percent on a chisel-plowed, Canisteo silty, clay loam in Iowa to about 55 percent on a chisel-plowed Mexico silt loam in Missouri. Wheel traffic eliminated tillage differences. Agricultural chemicals placed in untrafficked interrows may be more susceptible to leaching if they do not bind tightly to soil. In deciding where to place chemicals and which formulas to use, farmers should realize that rainwater can rapidly infiltrate soil in untrafficked interrows in cornfields, regardless of tillage used.

*National Soil Tilth Lab, Ames, IA  
Tom Kaspar/Mark Ankeny/Mark Prieksat,  
(515) 294-8873*

A portable, water-measuring device invented by ARS scientists will allow more efficient use of both urban and irrigation water supplies. It's particularly useful for making rapid evaluations in the field of how much water is needed to irrigate crops and avoid waste, and for locating sites where municipalities need permanent measuring structures to monitor water supplies. Flow rates can be measured more conveniently with the device, which also has more field-uses compared to older units. Only one or two people are needed to move and operate it. (PATENT 5,156,489)

*U.S. Water Conservation Lab, Phoenix, AZ  
John A. Replogle, (602) 379-4356*

Highly erodible clay soils can be protected by applying several tons per acre of an environmentally safe waste product from coal-fueled electric power plants. Some clay soils swell when wet, causing them to seal. Their ability to absorb water decreases, causing serious soil runoff. ARS scientists tested five wet clay-based soils (Vertisols, Aridisols and Alfisols) by simulating high-intensity rainfall—about four inches an hour—for 90 minutes. Applied before the test were about five tons per acre of gypsiferous material (GM) high in calcium and sulfur. It's a byproduct of capturing sulfur dioxide emissions from coal-fueled power plants. GM prevented soil from sealing, thus increasing water intake 3.6 to five fold, reducing water runoff loss by 10 to 50 percent, and lowering total soil loss by 33 to 40 percent. Clay soils are found in many parts of the United States, especially in the Southeast and Southern Coastal Plains. Using GM as an erosion control could dispose of millions of tons of a waste product from power plants while giving farmers a low-cost remedy for erosion-prone soils.

*National Soil Erosion Research, West Lafayette, IN  
L. Darrell Norton, (317) 494-8682*



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# Quarterly Report

of Selected Research Projects October 1 to December 31, 1994

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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University of Illinois  
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## Into the Marketplace

### Cooperative Research and Development Agreements

...With Morse Enterprises, Ltd., of Miami, FL, to evaluate and/or enhance natural citrus proteins that help plants ward off insects, nematodes and microbial pathogens. Using natural plant compounds that also provide nutrients will reduce pesticide use and costs. By enhancing defensive systems already present in plants, scientists hope to reduce production and postharvest losses. The cooperative effort will investigate methods to apply the compounds, which may be an alternative to fumigation with methyl bromide. The proteins, discovered in citrus by ARS scientists, may also work in other crops.

ARS Contact: Richard T. Mayer, U.S. Horticultural Research Laboratory, Orlando, FL, (407) 897-7304

Note: One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723/2824, sadams@asrr.arsusda.gov or lspurloc@asrr.arsusda.gov

The report is now available in several electronic formats.

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 416, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a particular company's product and/or research should be directed to the company itself.

...With Northrup King Company of Golden Valley, MN, to develop preparations of beneficial microorganisms to protect corn seed and seedlings from pathogenic fungi. Northrup King and ARS researchers are studying beneficial bacteria (*Pseudomonas spp.*), fungi (*Trichoderma spp.*) and other microorganisms as natural alternatives to chemical fungicides. These organisms protect corn seeds from infection by *Fusarium spp.* and *Pythium spp.*, soil-dwelling fungi that are serious corn pests in the Midwest and other regions. *Fusarium* causes root rot of young corn plants during dry conditions. *Pythium* causes seedling diseases that can destroy up to 60 percent of a crop when conditions are cool and wet. Researchers are testing a liquid fermentation process containing nutrients on which the beneficial organisms grow. These are added to powdered preparations that can be coated onto corn seeds using technologies developed by Northrup King.

ARS contact: Jack A. Lewis, Biocontrol of Plant Diseases Laboratory, Beltsville, MD, (301) 504-5356

...With Axis Genetics, Ltd., Cambridge, England, to bioengineer wheat to fend off Russian wheat aphids, reducing growers' dependence on insecticides. Axis scientists will collaborate with ARS researchers, who streamlined methods for giving wheat new genes. Since invading the United States in 1986, the green, 1/16-inch-long aphids have caused more than \$850 million in insecticide costs and related losses. Conventional breeding has produced aphid-resistant wheat varieties, but they aren't yet grown commercially.

ARS Contact: J. Troy Weeks, Crop Improvement/Utilization Research, Albany, CA, (510) 559-5673

...With EcoScience Corp. of Worcester, MA, to produce edible coatings for whole and lightly processed fruits and vegetables. The coatings will improve shelf life, reduce spoilage loss and extend the distances that produce can be shipped. Made of natural ingredients that give an attractive sheen to fruits like pears, apples, papayas and mangos, these coatings are more effective than other commercial coatings at slowing ripening. That's because the new coatings allow more ripening-related gasses to disperse through the fruit's peel. Other edible coatings will be used on lightly processed cut apples and peeled carrots to delay discoloration, dehydration and microbial-induced spoilage.

ARS Contact: Elizabeth A. Baldwin, Citrus and Subtropical Products Laboratory, Winter Haven, FL, (813) 293-4133



...With Rogers Seed Company, Nampa, ID, to breed snap beans with genetic resistance to golden mosaic virus disease. Until 1993, this disease was confined to Central America, Mexico and the Caribbean. But in 1994, whiteflies spread the disease to South Florida, where it wiped out many snap bean fields. Effective chemical controls aren't available. So ARS researchers will try to find genetic markers linked to disease resistance. Breeders can then use these markers to develop snap beans that withstand the disease in South Florida.

ARS Contact: Phillip N. Miklas, Tropical Agriculture Research Station, Mayaguez, Puerto Rico, (809) 831-3435

...With Ag Industrial Manufacturing, Inc., of Lodi, CA, to develop mobile equipment for automated measuring and mapping of destructive salt buildup—called salinization—in farm soil. Too much salt from fertilizer, irrigation water and other sources can kill crops, ruin farmland and pollute groundwater. Scientists intend to streamline a small, tractor-like vehicle, equipped with sophisticated instruments that sense and map salinity. Farmers and irrigation specialists could use the monitoring system to help halt salinization.

ARS Contact: Lyle Carter, U.S. Cotton Research Station, Shafter, CA, (805) 746-6391

...With Smucker Manufacturing Company of Harrisburg, OR, to develop a sprayer and an adhesive for applying eggs of lacewings and other beneficial insects to plant leaves for pest control. The sprayer does not damage eggs and the adhesive sticks eggs to foliage without suffocating the eggs. The eggs hatch and the young lacewings devour pests like aphids, whiteflies, leafhoppers, mites and scales that might harm the plant. Developed by an ARS entomologist, this biocontrol could replace insecticide sprays on various agricultural and horticultural crops.

ARS Contact: W.L. Tedders, Southeastern Fruit and Tree Nut Research Laboratory, Byron, GA, (912) 956-5656

## Biological Control

A new ARS test could reveal whether two Russian species of rust—a disease-causing, plant fungus—can be added to the natural arsenal against leafy spurge. This noxious weed invaded the United States from Eurasia early in the 19th century. Chemical controls are expensive and impractical, but rusts and other natural pathogens can reduce spurge's vigor and even kill it. ARS scientists are evaluating two rust species found outside the Russian city of Stavropol. At a site near Stavropol, they transplanted

spurge plants from Montana next to Russian spurge plants infected with the rusts. If the Montana weed readily becomes infected and succumbs, this will be a sign that American spurge has lost some rust resistance possessed by its Russian ancestors. In turn, that will increase the two rusts' potential to help U.S. ranchers battle the weed.

Range Weeds and Cereals Laboratory, Bozeman, MT  
Tony Caesar, (406) 994-6003

A bronze Chinese beetle also may join the corps of beneficial insects already imported to fight leafy spurge. Several years ago in China, an ARS scientist now based in Florida discovered the spurge-fighting potential of the 1/8-inch-long beetle, *Aphthona chinchihi*. Now, ARS researchers in Montana and France are conducting tests to ensure that this promising beetle won't significantly impact plants that are spurge relatives. Next, the scientists expect to seek federal approval to free the beetle in America. Spurge grows one to three feet high, crowds out forage and costs ranchers and others \$100 million a year in losses, including reduced forage and beef production.

Aquatic Weed Control Research, Fort Lauderdale, FL  
Robert W. Pemberton, (305) 475-0541

Musk thistle appears to have met its match in Texas in the flower weevil, a tiny European insect imported as a potential biological control. Musk thistles have spread in Texas from a single county in 1975 to at least 28 counties in 1993, infesting pastures, roadsides and recreation areas. To combat this wandering weed, ARS scientists released flower weevils (*Rhincyllus conicus*) at Kerrville in 1987. By 1993, 90 percent of thistles at the release site were infested with the weevils. Seed production was reduced an average of 81 percent. Also, the weevil had spread more than three miles from the release site. Flower weevils had not been previously released in a state as far south as Texas, although they have successfully controlled thistles in Missouri, Montana and Virginia. Plans are being made to distribute the weevil to other areas in Texas and Louisiana that are infested with musk thistle.

Grassland, Soil and Water Research, Temple, TX  
Paul E. Boldt, (817) 770-6530

A beneficial mite from Europe could fight thorny gorse thickets that invade many Pacific Coast pastures and recreation areas. ARS scientists raised gorse spider mites, known as *Tetranychus lintearius*, for Oregon and California—the first states to use the mites. No bigger than a pinpoint, the rust-colored, eight-legged mites suck gorse's cell contents. Gorse has yellow flowers, but their beauty is costly to ranchers along the Pacific Coast and in Hawaii. The weed forms nearly impenetrable thickets that block livestock from reaching nutritious forage plants. Gorse and the mites are both native to western Europe. ARS scientists



ran tests that show the mites won't feed on lupine, a gorse relative. The mites also don't nip other plants, animals or people. That's unlike gorse, which pricks hikers and campers with its thorns.

*Plant Protection Research, Albany, CA*  
Charles E. Turner/B. David Perkins, (510) 559-5975

## New and Improved Products

**Chlorine dioxide may prove an effective substitute** for straight chlorine now used to kill microbes in icy water that preserves the freshness of chicken meat. At poultry plants, chicken carcasses are plucked and gutted before they are submerged in chiller water to cool them to 40 degrees F or lower. ARS tests confirmed that it takes about four times as much chlorine to equal chlorine dioxide's bacteria-killing effect in chiller water. Bactericides kill pathogenic microbes that cause food poisonings, such as *Salmonella*, *Listeria*, *Escherichia coli*, *Campylobacter* and *Enterobacteriaceae*. In contrast to chlorine, chlorine dioxide does not form mutagens when added to chiller water at levels as potent as chlorine. Mutagen levels are regulated because they can cause cells to change. More than 500 municipalities rely on chlorine dioxide to sanitize drinking water. The chemical has not been used since 1976 for disinfecting chiller water. The new ARS findings are included in a petition to the Food and Drug Administration to approve this use.

*Food Safety and Health Research, Albany, CA*  
Lee S. Tsai, (510) 559-5878

**Trained taste panelists couldn't detect a difference** in flavor or texture between chocolates with a whipped cream filling and those with half the cream replaced by an Oatrim gel. Developed by ARS scientists, Oatrim is a fat substitute made from modified oat flour that is high in soluble fiber. When all the chocolates' cream was replaced by Oatrim, the panelists detected only a slight decrease in creamy flavor and a small difference in texture. A commercially produced, 1.4-ounce truffle with Oatrim filling contained 137 calories, 34 fewer than truffles filled with whipping cream. Oatrim, used commercially in a variety of foods, has been shown to lower cholesterol in humans. Calorie counts in Oatrim-filled candies could be lowered even further by using non-caloric sweeteners and bulking agents. (PATENT 4,996,063)

*Biopolymer Research, Peoria, IL*  
George E. Inglett, (309) 681-6363

**Adding cornstarch to biodegradable plastic cuts by 40 percent** the cost of making items from this plastic. Biodegradable resins have been too expensive to use as the sole ingredient in products such as plastic cutlery. ARS re-

searchers teamed with a chemist from Zeneca, Inc. of Wilmington, DE, to develop a formula that adds 25 percent cornstarch to environmentally friendly additives and biodegradable polyester resins. Plastic cutlery made from the new formula was durable.

*Plant Polymer Research, Peoria, IL*  
J.L. Willett, (309) 681-6432

**Latex gloves and infant pacifiers made from rubber** of native U.S. plants may be closer to reality. ARS scientists discovered that the size of a key molecule controls the rate at which plants produce rubber. The discovery boosts ARS technology for genetically engineering guayule, a desert shrub, and annuals like goldenrod and milkweed as domestic sources of natural rubber. Some 40,000 commercial products are made with natural rubber, harvested only from the tropical Brazilian rubber tree, *Hevea brasiliensis*. Over 2,500 other plants also make natural rubber, but in most the amounts are too small to be commercially exploitable. ARS scientists have found that the size of a molecule, called an initiator, controls the rate of rubber production. ARS scientists hope to insert into guayule and other plants new genes that will make more of the large initiator molecules, thus boosting the plants' rubber production and their potential as profitable new crops for U.S. farmers.

*Process Biotechnology Research, Albany, CA*  
Katrina Cornish, (510) 559-5950

**A specially designed microorganism can turn three sugars** from corn into fuel, yielding more ethanol from a bushel of corn. ARS researchers used a bacterial "bug" called *Klebsiella oxytoca*, which was genetically engineered in collaborative studies with a University of Florida researcher. In laboratory studies, the researchers produced up to 84 percent theoretical ethanol yield from the sugars—arabinose, xylose and glucose. These sugars are not presently used by industry in making ethanol. The engineered *K. oxytoca* carries alcohol-making genes borrowed from *Zymomonas mobilis*, an organism found in cactus plants. *Z. mobilis* is used in Mexico to make Pulque, an alcoholic drink containing 35 percent alcohol.

*Fermentation Biochemistry, Peoria, IL*  
Rodney J. Bothast, (309) 681-6566

**Sweet, juicy, Hawaiian starfruit can now be sold** on the U.S. mainland. ARS scientists ran experiments with more than 2,500 starfruit, also called carambolas, and some 300,000 fruit flies. The tests proved that chilling the fruit to 34 degrees F for 12 days kills any fruit fly larvae or eggs that might be hiding inside the fruit. This precautionary chilling ensures that Mediterranean and oriental fruit flies and melon flies can't hitchhike to the mainland to attack fields and orchards. The cylinder-shaped starfruit, four to seven inches long, ripens to a bright yellow. When sliced crosswise along its soft ridges, the fruit makes a unique,

star-shaped garnish or snack. Starfruit is low in calories and a good source of vitamin C and potassium. It's easy to eat fresh because it doesn't have to be peeled or seeded. Starfruit can also be added to stewed fruit dishes or used to make juices, wine, jellies, tarts and preserves.

*Tropical Fruit and Vegetable Research Laboratory,  
Hilo, HI*

*John W. Armstrong, (808) 959-4336*

**Baby food, beer and biofuels could be produced in a fraction of the time now required.** Starch from corn, barley and other grains is used as a key ingredient in making these products. ARS researchers found that a natural enzyme breaks down starch up to 10 times faster than current commercial processes. Alpha glucosidase, the speedy enzyme the researchers discovered two years ago, actually may have been used by Egyptians around 3500 B.C. to malt barley. The next step in the new enzyme research: cloning the gene that makes alpha glucosidase, then combining it with the gene for the enzyme alpha amylase. Alpha amylase holds up better under the high temperatures of processing starch. That genetic tailoring would lead to quicker, more efficient commercial production of starch derivatives.

*Cereal Crops Research, Madison, WI  
Cynthia A. Henson, (608) 262-0377*

**Corn tortillas get their flavor largely from one natural compound** in yellow corn flour. ARS researchers found the compound—called 2-aminoacetophenone—in yellow corn flour and pinpointed its importance to flavor. To enhance the quality of their products, makers of tortillas, taco shells, tortilla chips and other foods might monitor levels of 2-aminoacetophenone and perhaps boost flavor by increasing the amount of the component. The chemical apparently forms when hard corn kernels are softened in hot lime water before being ground into flour. To rate the flavor contribution of this compound and some 30 others, scientists used sophisticated lab instruments and appraisals by volunteers on an "aroma panel."

*Cereal Product Utilization Research, Albany, CA  
Ronald G. Buttery/Louisa C. Ling, (510) 559-5667*

**Turning citrus waste into commercial oils** is the focus of a cooperative study between ARS and Egyptian scientists. The oil extracted from lime seeds could be turned into cooking oils for U.S. and Egyptian consumers. Using state-of-the-art analytical methods, ARS researchers found that lime seed oils are comparable nutritionally to soybean oil. Natural flavor extracts from orange peels could give commercial value to these citrus wastes in Egypt.

*Food Quality and Safety Research, Peoria, IL  
William E. Neff, (309) 681-6389*

## Soil, Water and Air Quality

**A gene borrowed from yeast might yield bioengineered plants that clean up sites polluted by heavy metals.** ARS scientists and colleagues at the University of California at Berkeley uncovered a gene in lab experiments with *Schizosaccharomyces pombe* yeast. Eventually, they hope to insert the gene into hardy, fast-growing plants that could be seeded as metal scavengers for bioremediation of abandoned mines or other metal-contaminated lands. They have dubbed the gene *hmt1* for heavy metal tolerance. Like plants, yeast produces small molecules called peptides that bind to metals such as cadmium. The *hmt1* gene cues the yeast to make a protein that pumps more peptide-bound cadmium into vacuoles, structures that serve as cellular trash bags. Currently, the scientists are evaluating *hmt1* genes they inserted into test plants in a greenhouse.

*ARS/University of California Plant Gene Expression  
Center, Albany, CA  
David W. Ow, (510) 559-5900*

**Give a green thumb to the yellow pages.** Phone books, newspapers and other waste paper are being recycled into pellets that serve as "green manure" and ground cover. Soybeans do as well on soil with the pellets mixed in as they do on soil with a winter wheat crop mixed in as green manure. Other benefits: The pellets save the expense of tearing up the cover crop and may replace herbicides. ARS researchers in cooperation with colleagues at Auburn University have planted soybeans without applying herbicides before planting—with no loss in yields. Weeds are suppressed by either being smothered by the mulch or by some chemical compounds in the waste paper, or both. In addition, the researchers are cooperating on projects in North Dakota and Texas—using larger pellets two to four inches long—to hold down highly erodible soil. The larger pellets are applied with fertilizer spreaders while the smaller ones are applied by fertilizer dispensers.

*Soil Dynamics Research, Auburn, AL  
J.H. Edwards, Jr., (205) 844-3979*

**A motor-driven roof on wheels, called a rainout shelter,** could yield new scientific clues to help sustain Northern Great Plains rangelands during and after drought. ARS scientists developed the rainout shelter to create an artificial drought. Raindrops trigger the shelter's motor, which moves the roof to cover six 15- by 30-foot test plots. When the rain stops, the shelter uncovers these plots. They receive no surface runoff or underground water, because they're surrounded by foam-filled trenches and sit atop an impermeable layer of soil. Six adjacent rangeland plots are used to compare the artificial drought to natural conditions. Since drought often results in overgrazing, the scientists designed the experiment to separate effects of these two



plant stressors. In 1994, sheep grazed a set of four from each group of six plots. Of these four plots, two from each group will be rested and two will continue to be grazed in 1995 when the artificial drought is halted. This will help scientists identify the length of time that range plants need to rest from grazing once drought ends. Scientists will measure root growth, seed germination, tiller growth and soil moisture and structure.

*Fort Keogh Livestock and Range Research Laboratory,  
Miles City, MT*

*Rodney K. Heitschmidt, (406) 232-4970*

**Farmers can cut soil erosion and pesticide runoff** by at least 30 percent on silty soils by burying plastic drainage pipes under their crop fields, according to a long-term ARS study. The four-inch-diameter, perforated pipes allow water to drain into the soil more quickly after heavy rains. This reduces the chance that soil and pesticides will be washed away. Researchers found that burying the pipes three feet below a 10-acre test plot on silty, alluvial soil cut water losses and erosion by about one third. Runoff of the herbicide trifluralin dropped about 30 percent, compared to fields without the pipes. Trifluralin and other pre-emergence herbicides—applied to bare soil before crop seeds emerge—are particularly vulnerable to being washed away.

*Soil and Water Research, Baton Rouge, LA*

*Lloyd M. Southwick, (504) 387-2783*

**Ranchers can provide more pump water** for their thirsty livestock by installing small wind turbines. These pumps, powered by two or three aerodynamic blades, discharge water more than twice as fast as solar pumps and traditional, 16-blade windmills. A wind turbine pumped six to eight gallons of water per minute last year, compared to two to three for the windmill and one for the solar pump. The turbines power generators which are connected to submersible well pumps that lift water in a steady flow. Traditional windmills pump water in spurts by driving a piston pump up and down. The wind turbine system costs almost \$1,000 less than the \$6,000 price for a windmill. Solar pumps cost about \$3,500. Options that are being developed and evaluated by ARS include combining solar and wind power, and supplementing wind power with generators powered by a vegetable-oil-based fuel. Farmers and ranchers, pump dealers, electric utilities and government agencies are inquiring about the turbine-operated pumps. Two companies—Bergey Windpower, Inc., of Norman, OK, and World Power Technologies, Inc., of Duluth, MN, are manufacturing an improved version of an electrical controller, a device designed by the ARS team to turn the turbine's water pump on and off in response to wind speed.

*Conservation and Production Research Laboratory,  
Bushland, TX*

*R. Nolan Clark, (806) 356-5734*

## Human Nutrition

**Slashing the number of calories rats consume** throughout life is proving to avert age-related loss of brain function. It's well-known that life-long calorie restriction—the laboratory equivalent of fasting—dramatically prolongs life in laboratory animals. In this study, the brain cells of inactive old rats responded to specific chemical signals like those of young rats when they were served only 63 percent of the calories they would normally have eaten. Normally, the receptors for these chemicals, called muscarinic receptors, decline in mid-life. This leads to a loss of memory and some motor functions dependent on these receptors. But in the calorie-restricted rats, these receptors functioned 25 percent better than in a control group that got all the food they wanted. The finding is in line with studies by others showing that calorie restriction throughout life spares dopamine receptors, which control movement and decline dramatically with aging.

*Jean Mayer USDA Human Nutrition Research Center on  
Aging at Tufts, Boston, MA*

*James A. Joseph, (617) 556-3178*

**Women over 50 would benefit from visiting the gym** regularly to strengthen thigh and torso muscles, and thus prevent osteoporosis and related fractures. A year-long study of women aged 50 to 70 shows that strength training can preserve bone density and prevent losses in muscle strength, balance and physical activity. Such losses lead to falls—the greatest risk factor for fractures in the elderly. Twenty of the 39 volunteers strengthened muscles in the abdomen, the upper and lower back, the front and back of thighs and the buttocks on pneumatic equipment for just 40 minutes twice a week. Meanwhile, a control group of 19 women continued their normal lifestyle. At the end of the year, the trained group had gained one percent more bone density at the hip and spine compared to a 2.5 percent loss in the control group. They also increased strength in the trained muscles ranging from about 35 to 76 percent above the control group. Their balance improved 14 percent. And their spontaneous physical activity—excluding the training sessions—increased by an average 27 percent, whereas it decreased in the control group by nearly as much. The researchers are now testing the effectiveness of comparable exercises they developed that can be done at home with simple, low-cost leg weights and dumbbells.

*Jean Mayer USDA Human Nutrition Research Center on  
Aging at Tufts, Boston, MA*

*Miriam E. Nelson, (617) 556-3094*

As people age, they lose the automatic ability to regulate appetite and weight, according to a study of both young and older men. The findings help to explain two trends: People tend to gain weight and double body fat during middle age, then lose weight and body mass after age 65. These trends contribute to middle-age obesity and elderly malnutrition. In the study, nine older men kept on the extra pounds gained during three weeks of eating about 1,000 calories more than their normal intake each day. Ten young men, however, automatically ate less and dropped back to their normal weight over the following six weeks. In fact, much of the weight-loss occurred during the first 10 days after overeating, even though all volunteers were instructed to eat normally and not try to lose weight. Older men don't bounce back from undereating, either. After three weeks of eating about 800 calories less than usual, they didn't automatically increase their intake. The young men gained back more than they lost in the six-week follow-up despite the request to eat normally. The findings are the first direct evidence of an age-related loss of appetite control.

*Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Susan Roberts, (617) 556-3237*

A high-intensity strength training program can be an effective way for older people to maintain their weight while eating more. And it can reduce body fat, according to a study of 12 men and women in their late 50s, 60s and 70s. The volunteers lived at a USDA center during the three-month study so researchers could account for all of the calories they consumed, as well as measure how many calories they burned. Three times a week, the volunteers exercised muscles in the upper leg, upper torso and arms at 80 percent of the maximum weight each could lift at a given session. After 12 weeks, they were eating an average 15 percent more calories just to maintain their starting weight, while losing an average four pounds of body fat. One-third of those extra calories were burned during the resistance exercises themselves. Another one-third were needed to fuel an increase in the people's resting metabolic rate—the energy needed to keep the leaner body functioning while at rest. The research demonstrates the benefits of resistance training in helping older people balance calories burned with calories consumed while losing body fat and maintaining strength for daily activities.

*Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA  
Wayne W. Campbell, (814) 865-3453 (now at the Noll Physiological Research Center, Pennsylvania State University, University Park, PA)*

## Crop Production and Protection

An Arizona bumblebee is 500 times faster than honey bees in pollinating flowers. The carpenter bee, another U.S. native found in Arizona, is very hardy, surviving desert conditions. These are two examples of native bees that have commercial potential as crop pollinators. Honey bees from Europe annually pollinate U.S. crops worth about \$8 billion, but growers may need more help from other bees in the future. Scientists are now matching bees with crops they pollinate best. Pollen bees provide an alternative to honey bees, which face danger on at least two fronts. In many parts of the country, mites attack honey bees' and clog their breathing tubes. And, in the southwest, an Africanized strain crossbreeds with the European honey bee. The offspring are more defensive—thus more likely to sting and more difficult to manage—and are less effective pollinators. Non-honey bees are unaffected by mites or Africanized bees.

*Carl Hayden Bee Research Center, Tucson, AZ  
Stephen L. Buchmann, (602) 670-6481*

A new, simple, inexpensive applicator may bring back the days of crop dusting instead of spraying. ARS scientists have patented an over-the-row dust applicator to deliver crop pesticides, growth promoters and regulators, fertilizers and biocontrol agents in powdered form. The apparatus is ideal for grapes and tree fruits, and is expected to be excellent for cotton. Dusting crops reduces the amount of chemicals needed, improves the coverage of plant surfaces, and reduces soil, air, and water contamination. The new applicator will allow the use of lighter equipment that reduces soil compaction, eliminating the need for water. (PATENT 5,228,621)

*Appalachian Fruit Research Station, Kearneysville, WV  
Charles L. Wilson/Michael E. Wisniewski,  
(304) 725-3451*

Traps nabbed 50 percent more boll weevils when natural cotton chemicals were added. ARS scientists added the chemicals, called volatiles, to pheromone-based traps in field studies. The outdoor tests were a follow-up to lab studies showing that volatiles bolster a weevil's response to the pheromone. The pheromone itself is a natural chemical that weevils release to attract mates and signal the presence of cotton plants. ARS is patenting the volatiles, which may also help control southern pine beetles, a forest pest, and beet armyworms, a crop pest. (PATENT APPLICATION 08/015,260)

*Boll Weevil Research, Mississippi State, MS  
Joseph C. Dickens, (601) 323-2230*



**A device that looks much like a hand-held garlic press** could help farmers put the squeeze on elusive crop pests by revealing the efficiency of aerial pesticide spraying. Pests such as whiteflies like to hide on the bottom surface of crop leaves, where it's difficult for sprays to reach. Researchers developed the device, the dual-sided leaf washer, to quickly determine in the field whether pesticides are going where they're needed. A plant leaf is clamped between two heavy plastic discs and solvent is squirted through plastic tubes onto either side of the leaf. Plastic syringes draw off the rinsing solvent—now also containing pesticide residues washed from each leaf surface—into individual containers. The scientists can measure the amount of pesticide on each side of the leaf. Users can collect samples at a rate of one leaf per minute. The device will work on any leaf with a diameter of at least two inches, such as cotton, cantaloupe, cucumbers, corn and eggplant. (PATENT APPLICATION 08/303,808)

*Aerial Application Research, College Station, TX  
James B. Carlton, (409) 260-9351*

**A new, high-yielding, disease-resistant soybean** named Probst is available to U.S. producers of certified seed. It was named after Albert H. Probst, an ARS soybean breeder at West Lafayette, IN, from 1936 to 1970. The new cultivar, a cross between another ARS variety Spencer and the cultivar Resnik, was developed in the ARS/Purdue University cooperative soybean breeding and genetics project. In 46 field tests in 1992 and 1993, Probst had the highest two-year average yield of five publicly developed varieties and five advanced breeding lines. Probst has a gene called Rps1-k, which provides resistance to many races of *Phytophthora sojae*, a root rot fungus that regularly causes soybean yield losses.

*Crop Production and Pathology Research, West Lafayette, IN  
Jim Wilcox, (317) 494-8074*

**A new potato hybrid could save growers millions of dollars** in their fight against potato virus Y. The hybrid gets its virus resistance from the wild South American species, *Solanum tuberosum*. Researchers fused leaf cells of the wild species with those of domestic varieties to form the virus-resistant hybrid. Even after subsequent sexual crosses, offspring of the hybrid inherited and maintained the resistance. Currently, the best control for potato virus Y is virus-free certified seed, but screening certified seed potatoes is costly and time-consuming.

*Plant Disease Resistance Research, Madison, WI  
John P. Helgeson, (608) 264-5276*

**More than 600 species of native plants** can be germinated to restore western rangelands. ARS scientists have developed a "recipe" of moisture, temperature, light and other ingredients for those hard-to-sprout seeds. The plants are needed on rangelands that have been disturbed by fire, mining or large construction projects like pipelines, and can provide high-value alternative crops for farmers. Crop seeds are bred for uniformity, but trying to grow native range plants by trial and error can be costly and unsuccessful. That's partly because native plant seed is highly variable from seed to seed, as well as from species to species. Further, each native species requires a unique combination of dormancy, temperature and light regimes to germinate. Aside from their recipe, ARS scientists developed high-tech, refrigerated chambers that create ideal conditions for germinating the seeds. They've taken the same approach with weed seeds, because a weed's germination profile yields clues on how best to control it.

*Landscape Ecology of Rangelands Laboratory, Reno, NV  
James A. Young, (702) 784-6057*

**A new ARS-developed cultivar of kenaf**, a fiber crop, stands up to root-knot nematodes better than available varieties. And despite the presence of those nematodes, the new kenaf yields 200 percent more fiber than a popular variety. Chemical controls for the wormlike nematodes—a serious hurdle to growing kenaf in the United States—cost too much and can harm the environment. But in three years of tests in nematode-infested fields, the new variety, SF459, averaged 8,450 pounds of fiber per acre. A standard variety, Everglades 71, yielded only 2,800 pounds. SF459 suffers less direct damage from nematode feeding. Plus, it may ward off disease-causing fungi that often invade kenaf roots wounded by nematodes. One major U.S. kenaf company has already made SF459 its preferred selection. The United States now grows only 4,000 acres of kenaf, compared to 600,000 in China. But U.S. kenaf can supply many consumer and industrial products at less cost and with less hazard to the environment. Products include packing material, matting, textiles, oil- and chemical-spill cleanup products, livestock bedding and an assortment of recyclable—or recycled—paper products from newsprint to Bible paper.

*Conservation and Production Systems Research, Weslaco, TX  
Charles G. Cook, (210) 969-4812*

Home gardeners can soon welcome three new strawberries that ARS geneticists released to nurseries in 1994. Mohawk, Northeaster and Delmarvel are early-maturing, disease resistant varieties. In June, the plants produce firm, good-tasting fruit suited for shipping and local markets. Delmarvel and Northeaster were released cooperatively with scientists from Ohio State University and Rutgers University. Mohawk, released jointly with Canadian scientists, should grow well in southeastern Canada and northeastern United States. Northeaster, suggested for both the fresh and frozen markets, should also grow well in the northeastern United States. Delmarvel seems best adapted to the Middle Atlantic. All three varieties are expected to be available commercially for the 1996 growing season.

*Fruit Lab, Beltsville, MD*

*Gene J. Galletta, (301) 344-5652*

**Three rice fungicides can inhibit production of aflatoxin**, lab tests have shown. Aflatoxins are natural toxins that can be carcinogenic to humans and animals. In corn and cottonseed, the toxins are produced mainly by the fungus *Aspergillus flavus*. ARS scientists grew two strains of *A. flavus* in cultures containing the compounds pentachlorobenzyl alcohol (PCBA), fthalide or pyroquilon. All three strongly inhibited the accumulation of all aflatoxins without affecting fungal growth. PCBA had the greatest effect. Pyroquilon and fthalide already are used to prevent rice blast disease, caused by a different fungus. Next step: determining whether the compounds work as well in crops in the field.

*Cotton Pathology Research, College Station, TX*

*Michael H. Wheeler, (409) 260-9516*

**New varieties of range grasses—crested wheatgrass and Russian wildrye**—have a 25 percent greater survival rate on western rangeland. Generally, range grass seedlings are notoriously poor at surviving harsh climates. Some seedlings survive only a few days. Key to developing the new, hardier grasses was ARS scientists' discovery that just two seed traits—of more than a dozen—are crucial. These traits are the seed's weight and its ability to send forth a shoot from deep in soil. New crested wheatgrass and Russian wildrye varieties have been bred for these traits. Such cool-season grasses have the potential to be reliable sources of forage for cattle herds, improve wildlife habitat and slow erosion on about one half of the world's grazing lands.

*Forage and Range Research Laboratory, Logan, UT*

*Douglas A. Johnson/Kay H. Asay, (801) 750-3067*

**Plants probably aren't as thirsty as they used to be.** The reason: rising levels of carbon dioxide (CO<sub>2</sub>) in the atmosphere. Plants take in needed CO<sub>2</sub> through leaf openings called stomates, but gaping stomates let precious water escape. Researchers say today's higher CO<sub>2</sub> levels—

approximately 360 parts per million (ppm) vs. about 280 ppm a century ago—mean stomates need not open as wide, so less water is lost. In greenhouse tests, acacia plants grew in air with 350 ppm, 700 ppm or 1,000 ppm of CO<sub>2</sub>. Over five months' time, the plants all used about the same amount of water. But the acacia in 1,000 ppm of CO<sub>2</sub> grew an average of 23 feet, compared with 15 feet for plants in 700 ppm and only about five feet for plants in 350 ppm. Rising CO<sub>2</sub> levels during the past century could help explain how rangeland brush has proliferated in western states as plants' increased water use efficiency enables them to grow in areas where water is scarce.

*Grassland Protection Research, Temple, TX*

*Herman S. Mayeux Jr., (817) 770-6533*

**A genetic test for plant pathogens called MLOs** can, in a few days, "finger" insects carrying the disease. MLOs—mycoplasma-like organisms—damage fruits, vegetables and ornamental crops. A quick sampling of insects taken from a field would give farmers an early warning so they could nip the disease before it spreads throughout a crop. ARS scientists, who developed the original MLO test, have the new version in its experimental stage. Once perfected, the test can be used by diagnostic companies and extension offices. It identifies MLO-carrying insects more quickly and reliably than standard greenhouse tests that now take a week, month or even a year. Key to the test is a gene-multiplying technique called polymerase chain reaction, or PCR. Researchers use PCR to make millions of copies of specific MLO gene fragments—if any are present in insect test samples. That generates enough MLO genetic material to make a diagnosis.

*Molecular Plant Pathology Lab, Beltsville, MD*

*Robert E. Davis, (301) 504-5745*

**Using pine or Eucalyptus trees as windbreaks** bordering orange and grapefruit groves can reduce citrus canker to very low levels. This results in significant savings in the cost of disease control for growers. Caused by a bacterium, citrus canker can strip citrus trees of their leaves and cause fruit blemishes, resulting in yield and quality losses. ARS scientists tested windbreaks in Argentina where citrus canker is common. They found that the tree barriers—by reducing the speed of wind-carried rain water that carries the bacterium—were more effective than bacterial sprays in reducing the disease's occurrence and spread. Bacterial sprays are costly and have been only marginally effective.

*U.S. Horticultural Research Laboratory, Orlando, FL*

*T.R. Gottwald, (407) 897-7347*

**Overfertilizing poinsettia plants encourages attack by the silverleaf whitefly**—formerly known as biotype B sweetpotato whitefly—one of the ornamental's worst pests. To protect poinsettias, researchers also advise growers to use the calcium nitrate form of fertilizer. It apparently makes



poinsettias less attractive to the pest than ammonium nitrate, the most common form of nitrogen fertilizer. Whiteflies destroy plants by feeding on their juices. ARS scientists found more pests on fertilized poinsettia plants than on unfertilized plants. Researchers found female whiteflies laid more eggs on leaves of plants fertilized with ammonium nitrate, compared with those unfertilized or fertilized with calcium nitrate. Last year, the wholesale value of U.S. poinsettias exceeded \$170 million.

*Florist and Nursery Crops Unit, Washington, DC*  
*Jo Ann Bentz, (301) 504-8260*

**Cantaloupes can lose their sweet taste** if heavy rains fall just before harvest, often leaving them unmarketable. But researchers found this shouldn't happen if growers can harvest the melons within a day or two after a heavy rain. Or, if growers can wait a week, the fruit's sugar stocks will rebuild. Growers have thought that heavy rain dilutes the sweet taste when the fruit takes in excess water via the roots. Scientists now blame a sugar shortage rather than a water surplus. The results of laboratory studies by ARS and North Carolina State University were confirmed in field tests by ARS and the University of Arizona. After heavy rain, the roots stop working. They can't take up needed oxygen from rain-saturated soil. This shutdown signals leaves to halt photosynthesis, the plant's mechanism for using solar energy to produce sugars. The reduced sugar content shows up about four days after the heavy rain. Meanwhile, sugars already in the fruit have begun breaking down. The new findings will help save the melons' sweet taste. Plus, the field studies provide new information on when drip or furrow irrigation will help or hinder melon sweetness and other qualities.

*Crop Quality and Fruit Insects Research, Weslaco, TX*  
*Gene Lester, (210) 565-2647*

*Plant Physiology and Photosynthesis, Raleigh, NC*  
*Steven Huber, (919) 515-3906*

**A new, cold-hardy viburnum named "Cree"** has been distributed to cooperating wholesale nurseries. Plants are expected to be on the market in 1996 or 1997. ARS scientist Donald Egolf, who died in 1991, first evaluated and bred the new cultivar (*Viburnum rhytidophyllum*). "Cree," selected for its more compact growth habit and superior dark evergreen foliage, is cold hardy in USDA zones 5 to 8—the central to southern United States. In 13 years, this densely branched shrub has grown 8.5 feet high and eight feet wide. The plant remains evergreen in USDA zone 6 and may prove evergreen in zone 5. Its white flowers in two- to three-inch clusters open in mid-May in zone 7.

*U.S. National Arboretum, Washington, DC*  
*Ruth Dix, (202) 245-4762*

## Scientific Information Systems

### **What do woodpeckers and boll weevils have in common?**

They're both being pinpointed by computer maps. ARS scientists originally designed the maps to show cotton growers where and when boll weevil populations have reached damage levels. But in a new pilot study, scientists with the U.S. Department of the Interior's Fish and Wildlife Service are adapting the maps to track and protect endangered red-cockaded woodpeckers in a Mississippi wildlife refuge. The weevil maps sketch state and country boundaries, geographical features and areas such as farms, cities, parks and lakes. The maps are color-coded to show size and locale of weevil populations. USDA's Animal and Plant Health Inspection Service may also adapt the maps to pinpoint where and when to restrict pesticide spraying in environmentally sensitive zones.

*Boll Weevil Research, Mississippi State, MS*  
*Glenn Wiygul/John Reinecke, (601) 323-2230*

**Call it "Everything You Ever Wanted to Know About Leafy Spurge."** Purge Spurge, a new computerized knowledge bank on the noxious weed, will soon be available from ARS. As one of the worst seeds in the Northern Great Plains and Canada, leafy spurge infests at least five million acres in the United States. The database—thousands of pages of scientific articles, maps and photographs—is on CD-ROM. Farmers and land managers can search the disk for information on the biology, history and control of the weed. Purge Spurge will run on any personal computer using Windows 3.1 or later version with a CD-ROM drive.

*Northern Plains Soil and Water Research Center,*  
*Sidney, MT*  
*Neal Spencer, (406) 482-2020*

**Water flow in irrigated fields can now be measured** by custom-designed flumes that increase the accuracy of monitoring the amount of water used. A new ARS computer program, called Flume 3.0, custom-designs flumes as measuring devices for specific sites. Before, engineers had to select from existing shapes and sizes or design flumes through trial and error. Too frequently, design limitations were discovered only after construction. Using flumes can cut in half the amount of water that some irrigation districts now report as unaccounted for. Currently, that can be as much as 30 percent of the total water delivered to fields. Engineers say Flume 3.0 can design similar measuring devices for municipal water districts and sewage treatment plants to monitor water flow.

*U.S. Water Conservation Laboratory, Phoenix, AZ*  
*Albert J. Clemmens, (602) 379-4356*

## Animal Production and Protection

**U.S. Holsteins are still the No. 1 genetic source** worldwide for top milk production despite increasing foreign competition. Because of extensive exports of American Holstein semen and embryos, the top bulls in other countries consist of half, three-quarters or even full "U.S. genetics." Researchers evaluated the genetics of bulls from the United States, Australia, Canada, Denmark, France, Germany, Italy, The Netherlands, New Zealand and the United Kingdom by comparing the milk, fat and protein yields from the bulls' daughters. Results showed at least 90 sires of the top 100 bulls for each trait were from the United States. But continued genetic improvements are vital in maintaining American breeders' competitiveness. That's because increasing foreign use of U.S. genetics will narrow the gap between the United States and its competitors.

*Animal Improvements Program, Beltsville, MD*  
*Rex L. Powell, (301) 504-8334*

**A toxin that ARS scientists identified in ponderosa pine needles** causes pregnant cows to abort or deliver prematurely. The toxin is isocupressic [*eye-so-cue-PRES-ik*] acid. Pine-needle poisonings cause an estimated \$20 million a year in losses to western beef ranchers. ARS researchers found that four of five pregnant cows that were fed two doses of the toxin a day delivered premature offspring two to eight days later. Pinpointing the culprit compound may bring scientists closer to an antidote and yield other ways to protect pregnant cows and their unborn calves. One of the questions to be addressed is whether other pine needle and bark components in isocupressic acid's chemical family play a role in pine needle poisonings. Researchers also will find out if environmental conditions such as temperature cause toxin amounts to vary.

*Poisonous Plant Research Laboratory, Logan, UT*  
*Lynn F. James, (801) 752-2941*

**Controlling flies by using dung beetles** has become easier, thanks to a newly published aid to identify these beneficial insects. The information will help scientists develop integrated pest management strategies for controlling fly pests. Each year, the U.S. cattle industry spends millions of dollars to control flies that breed in dung and to pay for losses in livestock weight due to biting flies. Scarab beetles of the genus *Aphodius* are dung feeders. They break down the dung piles and, in the process, destroy the eggs and larvae of house, horn and stable flies that breed in dung. The new guide will aid in determining species of dung beetles that are most numerous, most widely distributed and perhaps most valuable in controlling fly pests.

*Systematic Entomology Laboratory, Washington, DC*  
*Robert Gordon, (202) 382-1792*

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# Quarterly Report

## of Selected Research Projects

January 1 to March 31, 1995

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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### Into the Marketplace

An easy-to-use test kit for fruits and vegetables can verify that residues of a fungicide, thiabendazole, are at or below safe levels. The fungicide protects potatoes, apples, bananas, lemons, oranges and other produce from microorganisms that cause molds and rots. ARS researchers and colleagues from Millipore/Immuno-Systems, Bedford, MA, developed the test kit that Millipore will begin selling this spring. The kit will simplify testing by regulatory agencies, food processors or retailers who run their own safety checks of produce. Growers, too, could use the test to ensure that thiabendazole levels in dips or sprays are adequate to safeguard the harvested crop without leaving excess residue. Proteins called monoclonal antibodies are the basis of the experimental kit, and are exposed to a liquid containing bits of peel that have been pre-soaked in methanol and water or homogenized in a blender. The proteins seek out and bind to the fungicide, revealing its

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723/2824, sadams@asrr.arsusda.gov or lspurloc@asrr.arsusda.gov

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 416, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a particular company's product and/or research should be directed to the company itself.

### Quarterly Report Now Available On Internet

The ARS Quarterly Report of Selected Research Projects is now available on the National Agricultural Library's Gopher server.

Press releases and other ARS news and information will be placed on the NAL Gopher server at a later date.

To view or download any section of the report via the Internet, point your Gopher client to:  
[gopher.nalusda.gov](http://gopher.nalusda.gov)

From the initial main menu, choose *Other Agricultural Publications*, then pick *USDA, ARS, Quarterly Report of Selected Research Projects*.

Those using a World Wide Web browser may wish to use the URL: [URL:gopher://gopher.nalusda.gov:70/11/ag\\_pubs/usda\\_ars\\_qr](http://URL:gopher://gopher.nalusda.gov:70/11/ag_pubs/usda_ars_qr)

presence by a color change. To prepare the peels and run the test doesn't require expensive lab equipment, and only takes about four hours, making the test faster than other methods for detecting the chemical.

*ARS Contact: David L. Brandon, Food Safety and Health Research, Albany, CA, (510) 559-5783*

### Two new flowering shrubs have raced from laboratory to market on the heels of their unusual colors.

ARS scientists imported and tested the two *Loropetalum* ornamentals, "Blush" and "Burgundy," which they released in 1993. Related to witch hazel, *Loropetalum* is a large evergreen shrub with graceful, arching branches. In place of the creamy white flowers and dark green foliage common to the species, "Blush" and "Burgundy" have shocking pink flowers in late winter to early spring and red-brown foliage. In warmer climates, the plant is evergreen but can lose its leaves in norther areas of USDA hardiness zone 7, the southern-tier United States. About 40 U.S. nurseries and gardens propagated the shrubs. Since their introduction, they have become a financial success within two years. Generally, newly introduced plants take three or four years to reach the marketplace. One South Carolina nursery that propagated 30,000 plants reported that income from 1995 sales should reach \$500,000. Yearly, U.S. retail sales of shrubs total about \$1.2 billion.

*ARS Contact: Tom Elias, U.S. National Arboretum, Washington, DC, (202) 245-4539*



## Patent Licenses

...To Trécé Inc., Salinas, CA, to commercialize synthetic versions of natural attractants to trap pepper weevils. Monitoring weevil populations by checking trapped weevils can help growers decide if and when to apply insecticides. Pepper weevils can seriously reduce yields of nearly all types of peppers in the southern-tier states, Mexico and Central America. The trap system—including ARS-patented attractants—was developed by ARS and Trécé Inc. under a cooperative research and development agreement. (PATENT 5,393,522)

ARS Contact: Robert J. Bartelt, Bioactive Constituents Research, Peoria, IL, (309) 681-6237

## Cooperative Research and Development Agreements

...With Z Corp of Albuquerque, NM, for developing absorbent materials from low-cost, high-volume agricultural waste, like soybean, cotton seed and rice hulls. The materials would solve two problems: what to do with agricultural waste and how to get rid of industrial waste. The materials, called granular-activated carbons (GACs), are similar to the black granules used in filter water in fish tanks. ARS researchers found GACs effective in removing toxic metals from certain industrial wastewaters. Current methods of removal are expensive, making it hard for small- and medium-sized businesses to adequately remove the toxic substances.

ARS Contact: Wayne E. Marshall, Environmental Technology Research, New Orleans, LA, (504) 286-4356

...With Bio-Con Systems, Mentone, CA, to test a lighter, sturdier trap for capturing destructive fruit flies, including the Mediterranean fruit fly. Bio-Con's patented trap updates a device called the McPhail trap, a heavy, bell-shaped glass bottle that breaks more easily than Bio-Con's plastic product. The Bio-Con model, called the Merrill trap, could also save time and labor. It holds more of the bait-and-water mixture for attracting and drowning fruit flies, so it doesn't need to be refilled as often. In California, Florida and Texas, McPhail traps and others are hung from trees and shrubs as sentries to detect fruit flies before their populations can build up. California maintains more than 18,000 McPhails in traplines. ARS researchers are testing the device in outdoor experiments on the islands of Hawaii and Kauai where the Medfly and relatives, such as the Oriental and Malaysian fruit fly and the melon fly, are already established. These flies pose a threat to mainland fields and orchards because they can attack more than 300 different kinds of fruits and vegetables.

ARS Contact: Nicanor Liquido, Tropical Fruit and Vegetable Research Laboratory, Hilo, HI, (808) 959-9138

...With Rhone Merieux, of Lyon, France, to refine an ARS-invented method using vegetable and other non-petroleum oils to formulate safer and less costly vaccines for Newcastle disease in poultry. Current inactivated vaccines use petroleum-based mineral oils as a vehicle to suspend tiny encapsulated droplets of vaccine antigen. An inactivated vaccine uses a "dead" virus as the antigen, the component that induces disease immunity, compared to vaccines that use live virus antigens. Inactivated vaccines made with mineral oil cannot be given to poultry within 42 days of slaughter, because of possible side effects, including skin and muscle lesions that make poultry unfit for processing. Now, synthetic, animal and many vegetable oils could replace mineral oil. An ARS researcher also found a combination of three compounds—modified castor oil, a diglycol and a triglyceride—that can encapsulate vaccine antigens in the oils. In studies, Newcastle vaccines made with various non-mineral oils protected chickens from the disease with little or no side effects. The approach may have potential with other vaccines for poultry, livestock and humans. Newcastle viruses can be highly contagious to poultry and other domesticated and wild birds. Exotic forms are considered among the most dangerous foreign diseases threatening the U.S. poultry industry. A California outbreak in 1972 took two years and \$56 million to eradicate. (PATENT APPLICATION 08/384,184)

ARS Contact: Henry D. Stone, Southeast Poultry Research Laboratory, Athens, GA, (706) 546-3431

...With Maine Biological Laboratories, Inc., Waterville, ME, to commercially develop a "dead" or inactivated virus vaccine for injecting into chicken eggs to protect hatched chicks from Newcastle disease. Vaccinating an embryo inside the eggshell, a common practice in the poultry industry, was pioneered by ARS scientists over 10 years ago. But today's in-egg or *in ovo* vaccines are live. Now an ARS scientist has proved effective an *in ovo* Newcastle vaccine that uses killed virus. This is safer for chickens. It will not cause disease symptoms—unlike live vaccines that sometimes do so. Plus, the dose is smaller than that given to hatched chicks. In tests, ARS scientists vaccinated embryos of White Leghorn chickens three days before they were due to hatch. Two months later, the grown birds were challenged with an exotic strain of Newcastle virus. Exotic strains are the deadliest form that potentially threaten U.S. poultry. No vaccinated chickens in the study showed disease signs. But the exotic virus strain killed all chickens in a group that was not vaccinated. The scientists also found that the killed-virus, Newcastle vaccine can be incorporated with *in ovo* vaccines available for avian influenza, *Salmonella* bacteria and other poultry pathogens. Each year, the



poultry industry spreads about \$16 million on inactivated vaccines to protect flocks from Newcastle and other diseases. (PATENT APPLICATION 08/269,325)

ARS Contact: Henry D. Stone, Southeast Poultry Research Laboratory, Athens, GA, (706) 546-3431

**...With Calgene, Inc., of Davis, CA, to evaluate the commercial potential of cotton hybrids that the company's scientists bioengineered to stop destructive caterpillars from eating cotton plants.** If the hybrids pass muster, farmers could get a new alternative to insecticides. The new hybrids are called transgenic because their new pest-killing gene comes from a different organism—the *Bacillus thuringiensis* bacterium, or Bt. In the bacteria and the plants, this gene produces a protein that makes cotton-bollworm caterpillars stop feeding. They eventually starve. The protein doesn't harm people or the environment. In lab and field studies, ARS scientists are measuring how well the transgenic plants resist heavy infestations of cotton bollworms. They're also comparing the hybrids with commercial varieties in yield and quality of cotton lint and in other important traits. Caterpillars such as bollworms and tobacco budworms cost cotton growers millions of dollars annually in chemical controls and lost yields.

ARS Contact: Johnnie N. Jenkins, Crop Science Research Laboratory, Mississippi State, MS, (601) 323-2230

**...With Suggs Machine and Welding of Butler, GA, for building automated peanut grading machines designed to reduce sampling, equipment and human errors.** The ARS-patented equipment removes debris from a five-pound sample taken from a five-ton shipment of peanuts. Then it removes the shells and sorts the peanuts by size. If the equipment fails to remove some peanuts' shells, those unshelled peanuts are separated by weight and sent back through the sheller. Workers using the current equipment must hand-pick the sample, and either remove the shells by hand or put the unshelled peanuts back into the sheller. Sorting prevents this problem and saves on labor costs. (PATENT APPLICATION 08/015,978)

ARS Contact: Floyd E. Dowell, National Peanut Research Laboratory, Dawson, GA, (912) 995-4441

## Human Nutrition

**The uncomfortable procedure now used to remove cells from the colon to detect cancer or look for pre-cancerous conditions may soon go the way of the dinosaur.** ARS and Johns Hopkins University researchers have developed a method for isolating viable colon cells from a fresh stool sample. Not only will the

technique allow doctors and researchers to bypass the invasive and expensive colonoscopy, it also will enable a more thorough inspection of the colon cells. Cells isolated from the stool represent conditions in the entire colon rather than a few areas scraped during biopsy. That's because the lining of the colon sheds more than a billion cells every day, most of which are still viable as they pass out of the body through the stool. The technique uses standard laboratory equipment and currently costs \$40 to \$50 per sample, compared to \$1,000 to \$1,500 for colonoscopy, which must be done in a hospital. When geared up for use by commercial laboratories, the cost will drop even further. And the test will take less time.

Beltsville Human Nutrition Research Center,  
Beltsville, MD

Padmanabhan P. Nair, (301) 504-8145

**Does extra vitamin C raise HDL cholesterol—the kind that helps prevent cholesterol buildup in the arteries?**

The answer is yes and no, according to an eight-month study of 138 men and women. The volunteers who began the study with vitamin C blood levels under one milligram per deciliter (mg/dL) benefitted from taking a one-gram, vitamin C supplement each day. HDL cholesterol increased an average eight percent, dropping the ratio of HDL to total cholesterol by eight percent. But the supplements had no effect in two-thirds of the volunteers—those who began with vitamin C levels at or above one mg/dL. The findings explain why other studies on this question have produced mixed results; the outcome depends on the subjects' baseline vitamin C levels. Researchers emphasize that it doesn't take supplements to raise plasma levels above the one mg/dL mark. Eating five servings of fruits and vegetables a day will easily do it. And these foods provide other protective substances besides antioxidants that aren't in supplements. Even three to four servings of the top vitamin C sources would do. These include citrus, broccoli, cauliflower, strawberries, papaya, potatoes and many dark, leafy greens.

Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA

Paul Jacques, (617) 556-3322

**What a woman eats while she's pregnant may have a life-long effect on the amount or location of body fat in her adult children.** Researchers have reproduced in laboratory rats the obesity noted in the young adult sons of Dutch mothers who were undernourished during their second trimester of pregnancy due to severe food rationing in World War II. Because rat pups are born more underdeveloped than human infants, researchers reasoned that the third and last week of gestation in rats is equivalent to the second trimester in humans. The

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mother rats were fed half the amount they would normally eat during the third week of gestation. As a result, their offspring were 28 percent fatter after puberty than those whose mothers got normal rations throughout pregnancy. The researchers also found that if mother rats were deprived of food during the first two weeks of gestation and then overate during the third week, the pups had more body fat in the abdominal area. In people, abdominal fat is linked to increased risk of heart disease and diabetes.

*Children's Nutrition Research Center, Houston, TX  
Marta L. Fiorotto, (713) 798-7146*

**The heart may be vulnerable to damage from oxygen free-radicals, according to a study of rats.** ARS researchers wanted to know why copper deficiency is hard on the heart muscle of test animals but not on other organs. They suspected it may be due to differences in antioxidant enzymes among the organs. These enzymes protect cells from oxygen free-radicals which are generated by normal metabolism. At least two of these enzymes require copper to function, so copper deficiency could leave cells more vulnerable to oxidative damage. The researchers found lower levels of four antioxidant enzymes—not just the copper-containing enzymes—in the rats' hearts compared to their livers. And they found this difference in control animals as well as copper-deficient animals. Enzyme activity ranged from 1-1/2 to 50 times lower in heart muscle cells of all the animals. In fact, the enzyme that was 50 times lower—catalase—requires iron rather than copper to function. This suggests that the vulnerability of the heart to copper deficiency and possibly to other conditions that increase oxidative stress is due to a relatively weak antioxidant defense system.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
Jack T. Saari, (701) 795-8499*

**One to two alcoholic drinks daily had a positive effect on young women's blood cholesterol, according to the first controlled-diet study of alcohol in young women.** Beneficial HDL cholesterol increased an average 10 percent while artery-clogging LDL cholesterol dropped eight percent. Women volunteers received the equivalent of two six-ounce glasses of wine or two ounces of liquor daily. Total cholesterol did not change. However, daily consumption increased levels of estrogen hormones from seven to 32 percent during the women's menstrual cycles. Estrogen hormones are thought to play a role in breast cancer, although how they do so has remained elusive. About 44 percent of American women drink alcoholic beverages at least once a month, so researchers with ARS and the National Cancer Institute wanted to assess the effects of alcohol as part of the diet

in women ages 21 to 40. This age group is rarely studied because blood lipids and other biochemical markers tend to fluctuate with female hormone changes throughout the menstrual cycle. Researchers reduced this variable by sampling blood when each woman's female hormone levels were at their lowest. To ensure that any changes in blood lipids were due to alcohol intake and not to dietary habits, the women were given the same diet with the same amount of fat—36 percent of calories—through the six-month study. The findings support evidence linking alcohol consumption to higher HDL levels in men and women.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Beverly Clevidence, (301) 504-8367*

**Eating green vegetables, citrus and other foods rich in folate (folic acid) may help keep the arteries open, reducing heart disease and stroke risks.** The finding is from a collaborative study of 1,041 elderly men and women still participating in the original Framingham heart study. A research team's new evidence confirms earlier data that elevated blood levels of the amino acid homocysteine increase the odds for significant narrowing of the arteries. Folate and vitamins B<sub>6</sub> and B<sub>12</sub> are needed to convert homocysteine into useful amino acids, and thus keep homocysteine blood levels in check. Researchers compared the levels of homocysteine, folate and vitamins B<sub>6</sub> and B<sub>12</sub> in the subjects' blood with artery narrowing. Subjects with the highest homocysteine levels were twice as likely to have significant narrowing—a loss of at least 25 percent of the inner diameter—as those with the lowest levels. Narrowing increased in step with homocysteine levels. The analysis also showed that insufficient levels of folate and, to a lesser extent, vitamin B<sub>6</sub> contribute to increased risk of artery narrowing. Like a see-saw, homocysteine levels go up as the vitamins go down, and vice versa.

*Jean Mayer USDA Human Nutrition Research Center on  
Aging at Tufts, Boston, MA  
Jacob Selhub/Paul Jacques, (617) 556-3191/3322*

**Copper deficiency ultimately reduces the ability of body cells to receive signals critical for nerve transmissions, immune response and heart rhythms and other functions.** A new study of laboratory rats has shown that this poor signal reception could explain the wide range of pathologies reported in copper-deficient animals—from heart muscle damage and depressed immune response to neurological problems. Researchers studied blood platelets from copper-deficient rats because platelets, like immune cells and nerve cells, await a chemical signal before they respond—to help form a blood clot, for example. They found a 36 percent drop in a substance critical in transmitting outside



signals to the cell's interior. That's because the cell had commandeered this substance—called GTP—to help supply the power it needed to stay alive. Normally, cells produce energy by a process that requires a copper-containing enzyme. But with little copper available, the cells compensated by switching to GTP—a production method that doesn't require a copper-containing enzyme. In so doing, however, the cells compromised their ability to receive incoming signals that prompt them when and how to respond and when to stop responding, as in the case of blood clotting.

*Grand Forks Human Nutrition Research Center,  
Grand Forks, ND  
W. Thomas Johnson, (701) 795-8411*

**Boosting a key amino acid in plants could help people get more zinc in their diets.** Raising methionine amino acid levels in a plant doesn't alter the plant's zinc content, but makes it possible for humans and animals to absorb more zinc, a valuable nutrient. In laboratory experiments, rats on a diet supplemented with methionine absorbed 82 percent of traceable dietary zinc, compared with 69 percent for rats on supplemental lysine—another amino acid—and 64 percent for rats with no additional amino acids. Dietary zinc shortages—a bigger problem in developing countries than in the United States—may be linked to depressed growth in children, slower wound-healing and difficult births. Although most non-vegetarian Americans get the bulk of their dietary zinc from meat, about 13 percent comes from cereal grains. These foods may become more important sources of zinc as people adopt current dietary recommendations.

*U.S. Plant, Soil and Nutrition Laboratory, Ithaca, NY  
William House/Ross Welch, (607) 255-8002*

## New and Improved Products

**Flavor and other eating qualities of chicken breasts generally are not affected by a range of cold-storage temperatures from 40 to 0 degrees F.** This finding from a new ARS study suggests consumers consider more than poultry's "fresh" or "frozen" label at the grocery store as a quality indicator. Current USDA regulations require processors to maintain chicken that is labeled as "fresh" above 0 degrees F until its delivery to retail distributors. USDA's Food Safety and Inspection Service (FSIS) has been reviewing the regulations in response to various concerns, including a claim that poultry chilled below 26 degrees is hard to the touch and thus is "frozen," not "fresh." As a result, FSIS asked ARS to conduct the quality study. ARS scientists based their evaluation on a trained panel of food testers and

other high-tech sensing technology called near-infrared (NIR) spectroscopy. The study involved 800 freshly processed unfrozen chickens obtained from a local processor. Scientists chilled the breast fillets to 40, 32, 26, 10 or 0 degrees F. After two days of chilling—and again seven days later—they evaluated 17 attributes of taste, texture and other qualities. They found no important differences due to the various temperature regimens. Scientists currently are evaluating the NIR data to see if it can answer a related question: What is the temperature history of chilled poultry?

*Richard B. Russell Agricultural Research Center,  
Athens, GA  
Brenda G. Lyon, (706) 546-3167*

**Bright-orange cucumbers loaded for the first time with beta carotene could be the end-product of cucumber breeding research.** An ARS scientist developed new cukes that can be bred into commercial varieties. Fruit from two breeding stocks of cucumbers contain one to 25 parts per million (ppm) of carotene. Cantaloupe have 15 to 20 ppm, and carrots have 75 to 150 ppm. If preserved, these cucumbers taste like any other pickle, but retain beta carotene that the body converts to vitamin A. Vitamin A is necessary for normal vision, bone growth and tooth development. Unlike carrots, cucumbers grow well in hot, humid climates of developing countries where many children suffer vitamin A deficiencies.

*Vegetable Crops Research Laboratory, Madison, WI  
Philipp W. Simon, (608) 262-1248*

**The dairy industry needs a more reliable method to detect residues of certain antibiotics in cow's milk.** Now it has one: an ARS-developed method that accurately detects all six antibiotics commonly used to treat and prevent mastitis, an infection of the udder in dairy cows. The Food and Drug Administration (FDA) puts strict limits on the levels of these antibiotics in milk. Two of the six—cloxacillin and ceftiofur—are difficult to detect by commercial screening test kits. Sometimes, today's tests err by indicating that the level of antibiotics is too high. The key to the new method is a chemical solvent, called acetonitrile. The scientists use the solvent to remove milk proteins from the sample. What's left is concentrated by evaporation. They then test the concentrated sample with a commercially available, antibiotic screening kit, called Delvotest-P. The new method is inexpensive, so it can be used for screening milk samples from individual cows, as well as from large tanker trucks. The FDA provides guidelines to farmers for checking milk samples, and requires dairy industry personnel to test tankers of milk for the six antibiotics.

*Meat Science Laboratory, Beltsville, MD  
Raida Harik-Khan/William Moats, (301) 504-8989*



A new ARS-patented process boosts the potential for a southwestern desert shrub to contribute to products ranging from lipsticks to lawn mower lubricants. Researchers defined the structure of lesquerella gum and developed a process to extract gums from whole lequerella seed or seed meal after the plant's oil is removed. These gums can be used in foods, pharmaceuticals, lubricants and plastics for lipsticks, crayons, wooden matches and other products. As a thickening agent, lesquerella gum could be used as widely as xanthan gum, a food thickener ARS researchers discovered in the 1960s that's used in many familiar food products such as salad dressings. (PATENT APPLICATION 08/228,316)

*New Crops Research, Peoria, IL*

*Thomas Abbott/Robert Kleiman, (309) 681-6306*

### Soil, Water and Air Quality

Some weeds may be bad for allergies, but good for cleaning up the environment. These plants selectively remove heavy metals such as lead, zinc and cadmium from contaminated soils. Other plant species accumulate radioactive isotopes such as uranium or cobalt. Alpine pennycress—a small perennial herb—has emerged as the best at removing cadmium and zinc after a three-year study in Maryland and at a Superfund cleanup site in a Minnesota landfill. Alpine pennycress can hold 30,000 parts per million (ppm) of zinc in its leaves without any loss in growth, compared to a 500-ppm limit for most plants. Pennycress and other "hyperaccumulators" can be made into "hay" annually, then burned for electricity generation. Their ashes can be recycled and marketed commercially. ARS researchers have finished the Minnesota test and are continuing lab tests in Maryland on different strains of pennycress. They have begun a field test at a smelter-contaminated Pennsylvania city park that has three-percent zinc levels in its soil. The pennycress is thriving where crops can't survive. The next step is to complete inheritance studies to find genes for hyperaccumulation from pennycress or ragweed and move them into common crops that grow larger, faster and are easier to harvest. Canola grown for hay is a possible candidate.

*Environmental Chemistry Laboratory, Beltsville, MD*

*Rufus Chaney, (301) 504-8324*

Years of searching for the ideal microbe to gobble up herbicides in the rinsewater from tractor-pulled pesticide tanks has ended. ARS found the microbe in sewage sludge at a municipal water treatment plant near Washington, DC. Once the microbe is done feeding, farmers can dump the water on the ground without fear of contamination. That frees farmers from having to store several thousand gallons of rinsewater a year while searching for a way to safely dispose of it. The microbe, *Klebsiella terrigena*, has a strong preference for the

organic nitrogen in herbicides, but turns up its nose at the inorganic form in fertilizer. Previously tested microbes ate only fertilizer nitrogen in the rinsewater and left the pesticides untouched. The new microbe degrades the major herbicides—atrazine, cyanazine, and simazine—after an initial treatment with ozone to begin the breakdown process. Other microbes have been found that degrade alachlor, metolachlor and 2,4-D after ozone treatment. After feeding, little is left but water and carbon dioxide. To treat rinsewater, farmers use two 55-gallon, cone-shaped tanks common on farms. An ozone generator, the only specialized equipment needed, is attached to one tank to pump ozone through the rinsewater for 12 hours. Then the rinsewater is pumped to the second tank where microbes completely degrade the pesticides in the next 24 hours.

*Environmental Chemistry Laboratory, Beltsville, MD*

*Cathleen Hapeman/Jeffrey Karns/Daniel Shelton, (301) 504-6451*

American lakes could be given a new life, free of water pollution from agricultural runoff. In 1985, ARS scientists began tracking pollution in Lake Chicot, AR. The lake is surrounded by 577 square miles of cotton, soybeans and rice. Lakes in such large agricultural drainage areas often have poor water quality because agrichemicals, soil and other pollutants wash into them. The study examined how suspended sediments and other contaminants can harm lake water quality and productivity. Based on the study, researchers came up with a viable solution—divert storm water around the lake and channel cleaner water into it. That practice improved the lake's water quality, lowered sediment and rejuvenated recreation and fish.

*National Sedimentation Laboratory, Oxford, MS*

*Charlie Cooper, (601) 232-2935*

Gypsum from coal-burning electric plants could be a low-cost, widely available soil enhancer. In tests with corn and pasture grasses, ARS scientists are finding that gypsum not only reduces the effects of soil acidity, but also supplies essential calcium, sulfur and boron. This allows plant roots to search more soil for water. Gypsum is one of many byproducts currently produced by scrubbers and other pollution control technology mandated by the Clean Air Act. ARS scientists are rating various byproducts to see which ones have a future as niche-market soil additives.

*Appalachian Soil and Water Conservation Research Laboratory, Beckley, WV*

*Virupax C. Baligar, (304) 252-6426*

Capillary electrophoresis (CE) helps keep the environment healthy while pinpointing mycotoxins in corn. CE, which separates compounds based on their



electrical charges, can be used to detect levels of mycotoxins produced by fungi that infect grain. When ARS researchers used CE analysis to check 20 corn samples, 99 percent less hazardous waste was generated than with high performance liquid chromatography, a standard analytical technique for detecting mycotoxins. Researchers are working on ways to reduce the cost of CE so that more scientists will use it, thus reducing chemical waste.

*Mycotoxin Research, Peoria, IL*  
*Chris Maragos, (309) 681-6266*

**Mixing composts in high-lead soil may reduce by two-thirds the amount of lead that gets into the bloodstream of children who eat the soil.** These were the results in rats given diets containing five-percent soil—similar to the amount eaten by young children who have an abnormal craving for soil. Such abnormal behavior is called pica. Soil fed to the rats came from inner city New Orleans. Lead levels were 1,600 parts per million (ppm). Urban soils commonly contain 1,000 to 10,000 ppm or more. Researchers measured lead in the rats' thigh bone because bone accumulates lead over time. Lead levels averaged 60 ppm in the bones of rats fed the soil without compost. That's compared to 20 ppm for rats fed soil with 10-percent compost. The compost binds the lead in the soil as it moves through the intestines, so more lead is eliminated from the body rather than absorbed into the bloodstream.

*Environmental Chemistry Laboratory, Beltsville, MD*  
*Rufus Chaney, (301) 504-8324*

## Biological Control

**A parasitic fly that kills fire ants in South America awaits new tests to see if it can control the pest in the United States.** Preliminary field tests in Brazil point to *Pseudacteon* flies as a natural way to combat the stinging fire ants, native to South America and invaders of 11 southern states and Puerto Rico. Studies show that the fly attacks only fire ants but does not attack beneficial insects or humans. In Brazil, the flies hover a quarter-inch above the ants, ready to attack. Once a female fly finds a large worker ant, she swoops down and—with her needle-like ovipositor—lays an egg either on the ant or inside its upper body. Then she flies away, before the ant can counterattack. The fly maggot gradually develops after working its way through the ant's neck into the head. Just before it reaches adulthood, the maggot eats everything inside the ant's head. Then an enzyme dissolves the tissue connecting the ant's head to its body—causing the ant's head to fall off with the developing maggot still inside. ARS scientists have received

approval for lab safety studies in the United States, as a prelude to field tests in this country.

*Medical and Veterinary Entomology Research*  
*Laboratory, Gainesville, FL*  
*Sanford Porter, (904) 374-5914*

**Honey bees are potential "couriers" for an environmentally friendly virus that kills crop pests.** A typical worker bee flies 500 miles and can search thousands of flowers for pollen and nectar that she carries back to the beehive. Scientists are recruiting female bees to drop off the virus on plants. They have patented a device that fits on the bottom of a standard beehive and dusts honeybees with a virus-talc powder mixture when they exit. As the bees buzz from flower to flower, the nuclear polyhedrosis virus and powder rub off their feet and legs and onto the blossoms. The virus is harmless to honeybees, but killed from 74 to 87 percent of corn earworm larvae in crimson clover fields where the bees carried the virus. That's compared to only 11 to 14 percent mortality in fields where bees were not used. Crimson clover is an important host plant for the first generation of corn earworms in early spring; later generations then attack corn, cotton and other crops. This biocontrol approach could be especially appealing to beekeepers who rent their bees for pollinating crops. (PATENT 5,348,511)

*Insect Biology and Population Management Research*  
*Laboratory, Tifton, GA*  
*John Hamm, (912) 387-2323*

**The codling moth, a pest of apple and pear trees, is the guinea pig in ARS' first area-wide pilot project for integrated pest management (IPM).** Rather than pesticides, the project's main IPM weapon will be a sex attractant that disrupts the codling moth's search for mates. Other methods discovered by ARS researchers may join the IPM package, including wasps released to attack the moth's offspring. Scientists at ARS and cooperating universities want to see how well IPM works when applied throughout a large area rather than on a single field or farm. Test sites are in five commercial apple and pear growing areas in California, Oregon and Washington. About 75 growers own the areas which range from 300 to 1100 acres. Earlier IPM studies have been on smaller plots. The project supports USDA's goal of helping producers apply IPM on 75 percent of U.S. crop acres by the year 2000.

*Tree Fruit Research Laboratory, Yakima, WA*  
*Carrol Calkins, (509) 575-5945*

**A new, easy-to-use trap that catches both male and female Mediterranean fruit flies is being tested in California and 12 countries.** A blend of chemical scents and colors lures flies inside a plastic cylinder, where they die after gobbling up a mixture of methomyl

insecticide and sugar. The chemical scents, ammonia and putrescine, mimic the smell of decaying fruit. The chemical blend can be fine-tuned to attract females before they mate and lay eggs inside fruit. Current traps attract only males, or contain liquid bait that is easy to spill in the field. ARS is seeking a patent on the new dry-bait trap, and several companies have expressed interest in developing it commercially.

(PATENT APPLICATION 08/231,213)

*Insect Attractants Laboratory, Gainesville, FL*

*Robert R. Heath/Nancy D. Epsky, (904) 374-5735*

**Adding tiny amounts of fungicide to the fungus *Gliocladium virens* could save this promising biocontrol agent from a harmful flaw when applied in cotton fields.** ARS scientists discovered *G. virens* naturally produces antibiotics that help cotton seedlings fend off disease-causing soil microorganisms. But *G. virens* also naturally produces a steroid called viridiol that can harm cotton plant roots. Laboratory tests showed that treating *G. virens* with minuscule doses of fungicide stops the fungus' viridiol output without hindering its antibiotic production. Next step: screening various *G. virens* strains to find one with genes to make antibiotics, but minus the genes for viridiol production. (PATENT 5,268,173)

*Cotton Pathology Research, College Station, TX*

*Charles R. Howell, (409) 260-9233*

**Beneficial wasps have one of the highest success rates of all biocontrols that protect U.S. crops.** Along with specialists from Canada and England, two ARS experts on the wasp superfamily, *Chalcidoidea*, are helping to develop a manual for these wasps. Several hundred pages of text and more than 1,500 illustrations help to identify over 700 groups of potentially beneficial wasps—some of which can be harmful. The key will help quarantine specialists at ports of entry, insect-rearing companies and state and federal laboratories to make a first-step identification to differentiate harmful from beneficial wasps.

*Systematic Entomology Laboratory, Washington, DC*

*Eric Grissell/Mike Schauff, (202) 382-1781/1784*

**Eggplant farmers are lining up to get help from a beneficial wasp that eats Colorado potato beetles.** In field tests in New Jersey, the wasps cut pesticide applications from 16 to two—a savings of \$20 to \$30 per spray. The wasp, *Edoum puttleri* Grissell, lays its eggs in beetle eggs. Any remaining eggs are stung. When young wasps hatch, they parasitize and kill more beetle eggs. Fewer pesticide sprayings not only save money and protect the environment, but make it safer for workers to hand-harvest eggplants. ARS scientists worked with scientists at Rutgers University, New

Brunswick, NJ, and the New Jersey Department of Agriculture. Local farmers are lining up to pay the small fee required to get in the program. Ten farmers are participating in the program on 100 acres of eggplants.

*Insect Biocontrol Laboratory, Beltsville, MD*

*Bob Schroder, (301) 504-8369*

## Animal Production and Protection

**Poorly fed cattle are at greater risk of carrying dangerous levels of *E. coli* 0157:H7 bacteria, the food-borne pathogen that killed four children who ate undercooked hamburgers on the West Coast in early 1993.** That's the finding of ARS researchers looking at cost-effective ways to reduce meat animal exposure to the deadly bacteria. Cattle subjected to dietary stress during shipment to market represent a high-risk group. Fasting animals have an imbalance of rumen microorganisms that normally keep the bad bugs at bay. The scientists' recommendation: Producers and marketers should feed cattle being sent to market regularly to maintain the normal balance of rumen microbes and suppress pathogenic bacteria like *E. coli* 0157:H7.

*Physiopathology Research, Ames, IA*

*Mark Rasmussen/Brad Bosworth, (515) 239-8242*

**Spraying newly hatched broiler chicks with a blend of bacteria from mature chickens' intestines helps the chicks fend off *Salmonella* infection.** In laboratory tests, researchers fed the blend, CF-3, to day-old broiler chicks. The next day, they fed each chick 10,000 *Salmonella typhimurium* bacteria. Ten days later, the chicks' intestinal levels of *Salmonella* were 99.9 percent lower than in untreated birds. CF-3 also protects chicks in tests at commercial poultry houses. Older broilers have higher intestinal levels of volatile fatty acids, such as propionic acid, that don't kill *Salmonella*, but do inhibit its growth. A newly hatched chick normally does not have enough volatile fatty acids to stymie *Salmonella*, but chicks treated with CF-3 have about the same ability to ward off *Salmonella* as a 21-day-old chicken. Natural mixtures such as CF-3 could lessen the now-common addition of antibiotics to poultry feed.

*Food Animal Protection Research Laboratory, College Station, TX*

*Donald E. Corrier, (409) 260-9342*

**Having too few brain receptors for a hormone could be a new-found reason why eight to 15 percent of sheep rams are reluctant to mate with ewes—and thus costly to ranchers.** Results of a recent study by ARS scientists and cooperators suggest that rams with enough receptor molecules respond to the hormone estrogen's chemical



signal, stimulating them to mate with ewes. The discovery is part of research that could lead to a test enabling sheep ranchers to evaluate a ram's breeding potential, and avoid losing money on reluctant rams. Scientists examined eight ewes and eight rams, including four that would only mount other rams. They counted estrogen receptors in the amygdala, a part of the brain that's thought to influence sexual behavior. The findings are the first evidence in any animal species that brain chemistry may influence sexual orientation.

*Range Sheep Production Efficiency Research,  
Dubois, ID*

*John N. Stellflug, (208) 374-5306*

**What do you do with more than 100,000 gallons of insecticidal dip after tick-proofing cattle at the U.S. border?** Turn it into harmless waste. ARS scientists and USDA tick eradicators found that microbes living in the dip help convert the liquid waste into harmless substances. The dip cleaned itself in a week or two when researchers added iron, magnesium salts and other nutrients, and monitored the dip's temperature, pH and oxygen. Soils contaminated with dumped waste dip can be cleaned in a similar manner. Over two years, it takes more than 100,000 gallons of dip to tick-proof American cattle before they leave a quarantine zone in south Texas. It takes even more anti-tick bath to dip Mexican cattle before allowing them into the United States. That's to prevent them from carrying cattle fever into the United States. The disease cost the U.S. livestock industry over \$1 billion a year before the culprit tick was eradicated.

*Soil-Microbial Systems Laboratory, Beltsville, MD  
Walter Mulbry/Jeffrey Karns/Daniel Shelton,  
(301) 504-6417*

**A parasite first found in dogs could be causing up to half of all cattle abortions, a problem that costs dairy producers in California alone about \$35 million annually.** Discovered and named by ARS researchers, the parasite—*Neospora caninum*—was implicated in about 50 percent of cattle abortions in a university study of approximately 700 dead calf fetuses. The ARS researchers are developing a test to detect the parasite in cattle. They aren't sure how the parasite is transmitted to livestock, but suspect wild carnivores such as coyotes eat an animal infected with the parasite, then pass the parasite in feces to contaminate livestock feed. Their recommendation to producers: Keep feed supplies covered so carnivores can't get in them. *N. caninum* has been identified in livestock all across the United States as well as Africa, Australia, Europe, Israel, Japan and New Zealand.

*Parasite Biology and Epidemiology Laboratory,  
Beltsville, MD  
J.P. Dubey, (301) 504-8128*

**A pond-side test that "borrows" a fragment of the disease-causing bacterium *Edwardsiella ictaluri* reveals within 30 minutes whether the bacterium is infecting the pond's fish.** *E. ictaluri* strikes swiftly and kills up to 50 percent of fish. The ARS-developed kit detects bacteria early, while fish are still healthy enough to eat medicated feed. The kit contains an antigen from the bacterium's surface. Blood of infected fish will contain antibodies against the bacterium; a few drops of a fish's blood are all that's needed to disclose a link between the tell-tale antibodies and the test-kit antigen. DiagXotics, Inc. of Wilton, CT, will receive a patent license from ARS to commercialize the test kit and expects to market it by late 1996. (PATENT 5,238,824)

*Fish Diseases and Parasites Research Laboratory,  
Auburn, AL*

*Phillip H. Klesius, (205) 887-4526*

**St. Croix sheep can produce three to six lambs every 24 months rather than the typical one to two lambs per year from traditional breeds—a 33 percent gain in productivity.** Most sheep breed in September or October and give birth in February or March—too late for lambs to reach the desired market weight of about 110 pounds by the prime Easter sales season. But St. Croix sheep will breed year-round, so producers can time lambings to make the most of the market. In three years of field tests in Arkansas, groups of St. Croix ewes were bred at two-month intervals throughout the year. Lambing percentages—the percentage of bred females who subsequently gave birth—were in the high 80s for animals bred in October through January and the low 70s for animals bred in June through September. The lowest rates were the mid-30s for animals bred in April and May. Other advantages of St. Croix sheep: They're heat-tolerant and resistant to stomach worms called nematode parasites that cost U.S. sheep farmers an estimated \$45 million annually.

*South Central Family Farms Research Center,  
Booneville, AR  
Michael A. Brown, (501) 675-3834*

## Crop Production and Protection

**What's the best time to attack the sweetpotato whitefly strain plaguing southwest cotton?** When there are an average of 1-1/2 sweetpotato whitefly nymphs per square inch on cotton leaves. Nymphs, an immature stage of the pest, are most vulnerable to chemicals. Holding off insecticide spraying until nymph density reaches 1-1/2 per square inch allows growers to minimize chemical use and whitefly damage. The new whitefly strain, also known as silverleaf whitefly, has caused more than \$200 million damage annually to U.S.

crops since 1991. Besides cotton, it attacks dozens of vegetable and ornamental crops mainly in Arizona, California, Florida and Texas.

*Western Cotton Research Laboratory, Phoenix, AZ  
Thomas J. Henneberry, (602) 379-3524*

**Up to 80 percent of the sticky sugars that sweetpotato whiteflies deposit on cotton bolls can be removed by enzymes sprayed on the crop during harvest.** Growers get a lower price for sticky cotton because the sugars gum up machinery in cotton gins and textile mills. But ARS researchers found and tested the new use for the enzymes, which are already commercially available. Scientists say the whitefly strain that has plagued southwest farmers in recent years can produce more than 500 pounds of contaminating sticky sugars per acre.

*Western Cotton Research Laboratory, Phoenix, AZ  
Donald L. Hendrix, (602) 379-3524*

**When Mediterranean and Mexican fruit flies eat a blend of red and yellow dye, the insects perish after a few hours in the sun.** ARS scientists in Hawaii and Texas are building on results from their early lab and field tests. They want to know if the dye blend might replace malathion, the chemical insecticide used in sprays and baits to quell fruit fly pests of citrus and other crops. The blend, called SureDye, is a product of PhotoDye International, Inc., Linthicum, MD. The dyes, Red 28 and Yellow 8, are registered by the Food and Drug Administration and used in drugs and cosmetics. Since malathion kills pests on contact, it may kill beneficial insects such as honey bees. By contrast, the red dye must be consumed. Then, activated by light, it apparently breaks down membranes, such as those found in the gut tract, killing the insect. ARS has asked the Environmental Protection Agency to approve large-scale field tests. ARS and PhotoDye have filed patent applications on SureDye technology. Scientists at other ARS locations are investigating SureDye's potential against other pests such as boll weevils and corn earworms. (PATENT APPLICATION 08/353,726)

*Crop Quality and Fruit Insects Research, Weslaco, TX  
Robert Mangan, (210) 565-2647*

*Tropical Fruit and Vegetable Research Laboratory,  
Hilo, HI  
Roy Cunningham, (808) 959-4300*

**Chandler, a new high-yielding ARS blueberry for pick-your-own farms and home gardens, should be available at retail nurseries by 1997.** This large-fruited, highbush variety ripens slowly, later in the season than Bluecrop, a standard since 1952. These qualities allow harvest over several weeks in July and August. That's an advantage for farms that rely on hand-picking rather than machines. Chandler shrubs

grow about five feet high. Limited numbers of plants are expected to be available to researchers and breeders by spring 1995.

*Horticultural Crops Research Laboratory, Corvallis, OR  
Chad Finn, (503) 750-8759*

**Spreading starch granules laced with malathion cut insecticide levels 99 percent without sacrificing corn earworm control.** In field tests, ARS researchers treated corn with 10 pounds per acre of granules laced with one-tenth of a pound of malathion. Control was as effective as if 100 times that much malathion had been sprayed. The reason: Starch granules stick to plant leaves, so the pesticide is concentrated precisely where needed and lasts longer. Corn earworms cost U.S. corn growers about \$1.5 billion annually in crop damage and chemical controls. Researchers are adapting the technology for wide-scale application, so farmers can use it.

*Plant Polymer and Mycotoxin Research, Peoria, IL  
Michael McGuire/Patrick Dowd, (309) 681-6222*

**A perennial legume may have the toughness to thrive in pastures in the harsh Appalachian hills.** ARS scientists have been growing tuberous vetchling in nursery plots in West Virginia and Pennsylvania for two years. They now have enough seed to begin field plantings for forage evaluation this spring. A previously uninvestigated relative in the pea family, tuberous vetchling has several advantages as a forage crop: It grows in poor droughty soil, spreads by rhizomes and provides a home for microorganisms that enable it to use nitrogen from the atmosphere. These qualities, combined with its large seed size, make it ideally suited for steep slopes that are more prone to erosion and difficult to seed or fertilize with equipment. The plant's regrowth from rhizomes enables the plant to persist in the nursery plots despite damage from deer which graze the herbage and dig up and eat the fleshy tubers.

*Appalachian Soil and Water Conservation Research  
Laboratory, Beckley, WV  
Joyce Foster, (304) 256-2809*

**New pea varieties that resist root rot could be closer to the market.** That's because ARS scientists have found how to rapidly identify experimental breeding lines. Common root rot is the most destructive root disease of peas worldwide. The fungus *Aphanomyces euteiches* causes it, and no chemical control is available. The new test uses a chemical compound to identify pea plants least hospitable to fungi. The test works by measuring the chemical's reaction to compounds made by the fungus. Low reaction indicates only a small amount of fungus—meaning the plant is resistant. Until now, scientists searching for resistance faced a time-consuming task—by either peering through a microscope



to count individual spores infecting root tissue, measuring root disease severity or taking seed yield measurements.

*Vegetable and Forage Crops Production Research,  
Prosser, WA*

*John M. Kraft, (509) 786-9257*

**The boll weevil's "sweet tooth" helped scientists breed cotton that's too "bland" for it.** A female weevil tastes a cotton bud to gauge whether it's rich in sugars her larvae need to grow. If the sweetness meets her exacting standards, she'll lay an egg in the bud. To discourage her, ARS scientists have bred low-sugar cotton germplasm lines. In 1990 and 1993 field tests, the new lines had only about half as many eggs as commercial varieties. The "low sugar" genes in the new lines originated from primitive Mexican and Central American cottons. Cotton breeders could develop the new lines into high-yielding, commercial varieties.

*Cotton Host Plant Resistance, Mississippi State, MS*

*Jack C. McCarty/Paul A. Hedin, (601) 323-2230*

**The first navy dry beans with genetic resistance to two key diseases are now available to commercial breeders.** ARS and cooperating university scientists in Michigan and North Dakota developed and released two new, high-yielding navy bean lines, BelMiDak Rust-and-Mosaic Resistant-10 (RMR-10) and BelMiDak RMR-11. Both resist all 65 races of the bean rust fungus, *Uromyces appendiculatus*. They also resist all known strains of bean common mosaic virus, including a new strain found in Idaho. The new strain triggers suicide cell death in infected plant tissue. The fungus and virus cause leaf diseases that reduce yields up to 30 percent and can wipe out an entire crop under extreme conditions. A Guatemalan bean cultivar introduced in the late 1940s supplied the new lines' genetic sources of rust resistance. The new plants are early maturing, upright, short vines that produce white, oval seed.

*Molecular Plant Pathology Laboratory, Beltsville, MD*

*J. Rennie Staveland, (301) 504-6600*

*Vegetable and Forage Crops Production Research,  
Prosser, WA*

*Matt J. Silbernagel, (509) 786-3454*

**Sweet, plump "Helena" apricots from ARS could be available in supermarkets nationwide within a few years.** Fruit from this new, deep-orange-colored variety is ideal for eating fresh because it's firm, smooth and not mealy. "Helena" ripens in early June, after Katy and about a week before Patterson—two of the best-selling California varieties. Over the past seven years, ARS researchers scrutinized an estimated 7,500 "Helena" apricots from experimental plantings at about 24 commercial orchards in California, the nation's leading

apricot producer. The new variety can be planted in other states that produce commercial apricots. As a bonus, its trees self-pollinate. That means growers and backyard gardeners won't have to plant another kind of apricot nearby to furnish pollen for "Helena."

*Horticultural Crops Research Laboratory, Fresno, CA  
Craig A. Ledbetter, (209) 453-3064*

**Creating soybean varieties that produce certain antioxidants could eliminate the estimated five- to 20-percent losses caused by ozone pollution.** ARS scientists tested 20 soybean lines or varieties that have varying amounts and kinds of naturally occurring antioxidants, called flavonol glycosides. They found that only those plants with one or more kinds of certain glycosides could tolerate high ozone levels. One of these plants, a commercial variety called "Lee," was tolerant not only to ozone, but also to excess soil manganese. That suggests the antioxidant could protect soybeans against multiple stresses, such as manganese, ozone and even ultraviolet rays. Scientists are searching for the genes controlling production of antioxidants to use in creating ozone-tolerant varieties. They also want to create improved synthetic versions of the antioxidants to spray on crops.

*Climate Stress Lab, Beltsville, MD*

*Charles D. Foy, (301) 504-5522*

**Sweltering summer days may no longer hamper the health, longevity and survival of certain maple trees growing in city landscapes.** Many red maples (*Acer rubrum* L.) and Freeman maples (*A. x freemanii* E. Murray) are popular landscape trees that sometimes cannot tolerate parched soil under concrete sidewalks. ARS and Iowa State University scientists conducted two laboratory experiments to screen six red maples, six Freeman maple cultivars and three unnamed red maples for their tolerance to high root-zone temperatures. They measured above and below ground growth and leaf chlorophyll content of trees at three soil temperatures—75, 84 and 93 degrees F. Of the 15 maples tested, "Autumn Flame," "Jeffersred" and "Schlesinger" appeared more resistant to high temperatures; whereas "Franksred" and "Indian Summer" were more sensitive. Next, the scientists plan to check out these results in field tests.

*U.S. National Arboretum, Washington, DC*

*Alden Townsend, (202) 245-4535*

**An unusual trait in plants—underground stems—was discovered in two new native populations of fourwing saltbush, a nutritious forage for livestock and wildlife.** The shrubs found on New Mexico rangeland could be forerunners of improved varieties for wider use on range habitats in the West. Normally, fourwing saltbush

spreads only by seed, but the new strains also spread by underground stems. The trait appears to be genetic, an indication it could be used to breed varieties that would provide more forage for grazing livestock and wildlife, better control erosion on disturbed lands and offer a new landscape option on private and public lands.

*Jornada Experiment Range, Las Cruces, NM*  
Jerry R. Barrow, (505) 646-7015

**Bacterial toxins delivered via biotechnology could become a nemesis to banded sunflower caterpillars that gnaw sunflowers on the Northern Great Plains.** ARS scientists found young banded sunflower caterpillars more vulnerable than older larvae to *Bacillus thuringiensis* (Bt) toxins. As genetically engineered corn, cotton and potatoes with insecticidal Bt genes near commercialization, researchers anticipate similar transformation of sunflowers to resist insect pests.

*Oilseeds Research, Fargo, ND*  
John F. Barker, (701) 239-1278

**A new atlas of pollen grains from nearly 400 species of flowering plants will help track the travels of devastating migratory crop pests such as the corn earworm.** This information can help growers stop pests at their source before they spread and wreak damage over a wide area. Researchers can check pollen grains taken from insects' bodies to pinpoint where the pests foraged before they began wandering. As part of a massive area-wide pest management study based in Texas, ARS and university scientists in 1990 began compiling a scanning electron picture atlas that depicts magnified whole pollen grains. Each species of flowering plants makes its own distinctive-looking pollen grains, so the grains can be vital clues to determining where a migratory pest originated. Previous pollen guides showed grains "by the slice," making it difficult to identify whole grains found on captured insects. So far, the new atlas identifies pollen of 398 plant species in the southern United States.

*Areawide Pest Management Research, College Station, TX*  
Gretchen D. Jones, (409) 260-9351

### Scientific Information Systems

Western cotton growers can now field-test the latest version of a computer program, called CALGOS, for advice on how much water and nitrogen fertilizer to apply—and when. This year, ARS offered the experimental program to growers, farm advisors, consultants and other researchers. Their suggestions will be used to fine-tune the program. CALGOS simulates the growth of five of the

leading western cotton varieties. It will be suitable for growers who use furrow, drip or overhead sprinkler irrigation. CALGOS gets its name from California, frequently the nation's top cotton producer, and from *Gossypium*, part of cotton's scientific name. It was produced by a visiting Israeli scientist in cooperation with ARS researchers at Fresno and Shafter, CA. To create CALGOS, they adapted a similar program, GOSSYM-COMAX, developed by other ARS researchers and Mississippi State University colleagues. CALGOS requires an IBM-compatible computer with Windows 3.1.

*Water Management Research Laboratory, Fresno, CA*  
Avishalom Marani, (209) 453-3101

**Twenty years of data is the basis for a prototype computer model that may help reduce the amount of herbicide needed to zap velvetleaf weeds.** Velvetleaf, a major pest in U.S. corn and soybean fields, infests over 25 million acres of soybeans and costs \$250 million annually to control. The model can predict when it is practical and economical to use herbicides to control the weed on fields where farmers rotate soybeans and corn. The model relies on economic thresholds where a herbicide is used only when the potential yield loss from weeds exceeds the control cost. It also relies on biological controls like *Verticillium spp* wilt that work with economic thresholds to reduce herbicide use. Simulations where velvetleaf was infected with wilt in six out of 20 years indicated that economic return would increase eight percent and the number of years herbicides were necessary would be reduced 13 percent. By using the threshold approach, farmers could increase their profits and lower the number of herbicide applications with more innovative and environmentally sound weed management.

*National Soil Tilth Laboratory, Ames, IA*  
Doug Buhler, (515) 294-5502

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# Quarterly Report

of Selected Research Projects

April 1 to June 30, 1995

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

About 1,500 Colorado farmers are getting daily reports on irrigation needs and pest problems "beamed up" via satellite by two commercial firms. ARS and Colorado State University scientists worked out the cataloging and analysis of data for this computer system. Irrigation reports are based on a statewide, 25-station meteorological network, administered by the scientists. All day, the network collects and processes weather data. At night, computers deliver the informa-

**Note:** One or more scientists familiar with each research project are listed for further information. If the scientists are unavailable, others at the same telephone number may also be familiar with the work. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723/2824, sadams@asrr.arsusda.gov or lspurloc@asrr.arsusda.gov

Items marked with the word PATENT are being patented by ARS. Patent or patent application numbers are included. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 416, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a particular company's product and/or research should be directed to the company itself.

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## New Section Names

Beginning with this issue, some section names have been changed and others have been added to make it easier for readers to locate items on particular subjects.

tion to scientists who compile it and forward the complete package to the two companies. In the morning, Colorado farmers can find out precisely how much water their crops will need that day. They also get early alerts and advice on identifying and tracking insect and disease infestations across the state.

*Water Management Research, Fort Collins, CO  
Harold R. Duke, (970) 491-8230*

Microorganisms discovered by ARS scientists are key ingredients in two new commercial products registered by the Environmental Protection Agency as the first postharvest biofungicides. Cooperative research and development agreements between ARS and two companies resulted in these natural components being used to control rot in stored fruit. ECOGEN of Langhorne, PA, made ASPIRE from the yeast *Candida oleophila*, found on tomatoes. Patented by ARS and Israeli scientists, the yeast combats postharvest rot on citrus and apples. EcoScience of Worcester, MA, developed BIO-SAVE 11 from *Pseudomonas syringae*, a bacterium that fights rot on apples, pears and citrus. This organism was isolated from the surface of apples and is being patented by ARS. California's Environmental Protection Agency concurrently registered BIO-SAVE 11 as a biofungicide. The current worldwide market postharvest treatments is about \$18 million a year for citrus and \$8 million for apples. (PATENT 5,425,941—yeast; PATENT APPLICATION 07/618,437—bacterium)

*Appalachian Fruit Research Laboratory,  
Kearneysville, WV  
Charles L. Wilson/Wojciech J. Janisiewicz,  
(304) 725-3451*

A new tomato just reaching some New York grocery stores is the first to carry a gene with an ARS pedigree. A license agreement with ARS permits DNA Plant Technology Corp., Oakland, CA, to use the gene to prolong freshness and flavor of more than a dozen fresh fruits and vegetables. DNAP biotechnologists designed the new Endless Summer tomato. Earlier, ARS and

University of California at Berkeley researchers found a key gene in zucchini and tomato and retooled it to keep production of a natural plant hormone, ethylene, turned off. Ethylene occurs naturally in tomato and many other plants. In nature, once ethylene is turned on, it stays on, causing fruit to ripen, but then overripen and rot. Most commercial tomatoes are picked before ripening is completed. This shortens the time the fruit can stay on the vine to naturally develop sugars and acids crucial to hearty flavor. Tomatoes with the rebuilt gene can stay on the vine longer to enhance flavor. Later, when exposed to ethylene in the warehouse, they soften and turn red. Endless Summer tomatoes are now being grown in Florida and test-marketed in New York. DNAP expects to sell them throughout the country by 1997. (PATENT APPLICATION 07/579,896)

*ARS Contact: Athanasios Theologis, ARS/University of California Plant Gene Expression Center, Albany, CA, (510) 559-5900*

## Patent Licenses

**...To Prepeeled Fruit, Inc. of Groveland, FL, to use ARS patented technology to prepeel citrus with commercially available food-grade enzymes.** That eliminates hand peeling and allows more precise control of portions. Also, the process removes the bitter white portion of grapefruit peel. Prepeeled fruit is ideal for school lunch programs and restaurants. Prepeeled Fruit incorporated the technique in a new processing plant it built in a small rural town in central Florida. Recently opened with local personnel, the plant can process about 50,000 pounds—about 100,000 pieces—of fresh fruit each eight-hour shift. When fully operational, the plant expects to hire about 100 people. (PATENT 4,284,651)

*ARS Contact: Robert A. Baker, Citrus and Subtropical Products Laboratory, Winter Haven, FL, (813) 293-4133*

**...To Neogen Corp., Lansing, MI, to develop a commercial kit that detects a medication called salinomycin in food and poultry feeds.** Salinomycin is added to broiler chickens' feed to prevent coccidiosis, a disease that costs U.S. poultry producers an estimated \$450 million annually in medication and production losses. The kit will use monoclonal antibodies—the same basic principle as home pregnancy tests—to check whether any salinomycin residues linger in tissues of slaughtered chickens and whether salinomycin has been properly mixed into feeds. Salinomycin is not a synthetic chemi-

cal, but is prepared from fermentations of natural microorganisms. (PATENT APPLICATION 08/081,591)

*ARS Contact: Larry H. Stanker, Food Animal Protection Research Laboratory, College Station, TX, (409) 260-9306*

## Cooperative Research and Development Agreements

**...With Defense Research Technologies, Inc. of Rockville, MD, to improve a system for determining the number of insects in a grain sample by detecting the insects' feeding sounds.** Called ALFID (Acoustic Location Fixing Insect Detector), the ARS-developed system captures and analyzes the sounds insects make as they feed on the grain. But the sensors often only detect the loudest sounds—meaning smaller insects could be missed. Scientists want to incorporate the company's technology that uses compressed air to amplify sound waves from even the smallest insects. ALFID could then do a better job of picking up fainter insect feeding sounds, especially from small larvae living inside grain kernels.

*ARS Contact: Dennis Shuman, Insect Attractants, Behavior and Basic Biology Research Lab, Gainesville, FL, (904) 374-5737*

**...With the Soil and Water Conservation Society, Ankeny, IA, to market a computer program, known as RUSLE—Revised Universal Soil Loss Equation.** RUSLE increases the accuracy of predicting soil erosion by water, based on computer analysis. ARS scientists developed the original version in the 1960s to estimate soil erosion by water and to protect farms and rangelands against soil loss. ARS scientists will continue to refine the basic mathematical relationships and expand the database for the equation. SWCS will educate and train farmers, ranchers, land-use managers and agency personnel to help one million land users comply with the soil conservation provisions of the 1995 Farm Bill. SWCS also is continuing to distribute the latest input data developed by ARS and USDA's National Resources Conservation Service. RUSLE is being used to develop conservation compliance plans to reduce soil erosion on more than 34 million acres of farmland that will come back into production as Conservation Reserve Program contracts expire this year.

*ARS Contact: George R. Foster, National Sedimentation Laboratory, Oxford, MS, (601) 232-2940*



**...With Cargill, Inc., Minneapolis, MN, to develop a newly isolated microorganism that could help protect silage from spoiling** when the silo is opened to remove the silage for feeding dairy cows. Farmers already inoculate silage with microorganisms to speed fermentation. But inoculants now on the market don't protect against damaging yeast and fungal growth when silage is exposed to air. ARS and industry scientists isolated a strain of *Lactobacillus buchneri* from alfalfa silage. This organism produces compounds that inhibit yeast and mold growth in corn silage. An *L. buchneri*-based inoculant could reach the market within two years and cost about the same to manufacture as current silage inoculants.

*ARS Contact: Richard E. Much, U.S. Dairy Forage Research Center, Madison, WI, (608) 264-5245*

**...With Summit Plant Laboratories, Inc., of Fort Collins, CO, to develop a way to commercially produce sugarbeet clones.** Clones—genetically identical plants—would advance breeding of commercial hybrids that resist disease or need less fertilizer. No sugarbeet clones are commercially available. And since this plant doesn't self-pollinate, it's difficult to obtain the large numbers of genetically similar plants needed for research and breeding. Clones would give plant breeders and researchers a reliable standard for comparison, year after year, to help further the competitiveness of the domestic sugarbeet industry. Private as well as public plant breeders would have access to the clones.

*ARS Contact: Lee W. Panella, Crops Research Laboratory, Fort Collins, CO, (970) 498-4230*

**...With Valmont Industries, Inc., of Valmont, NE, to develop a way to automate the delivery of irrigation water based on plant temperature.** Such a precision farming system might pay for itself in water savings. ARS-developed prototypes are being tested in California, Mississippi and Texas. One example is the use of flashlight-sized, infrared thermometers, mounted on an irrigation system that circles a field. Leaf temperatures are read every six seconds around the clock. Red lights on the irrigation system and at a computer console flash when the plant needs water to cool down. This temperature-time threshold is based on the discovery by ARS scientists that each crop has its own preferred temperature range at which it grows best. If this prototype were automated, farmers would insert a different computer cartridge into the computer for each crop they're watering. Then, the computer would decide when to water.

*ARS Contact: Dan Upchurch, Plant Stress and Water Conservation Research, Lubbock, TX, (806) 746-5353*

**...With Pharmacognetics, Inc., of Bethesda, MD, to investigate natural compounds from microorganisms and plants of Latin American rain forests as potential new environmentally friendly products.** Biopesticides, pharmaceuticals and other products could emerge from the research. ARS scientists will examine extracts from the microorganisms and plants to see if they contain biologically active compounds. If so, they will isolate and identify the active chemicals. For chemicals having biopesticidal properties, the ARS scientists will focus on those that, in tiny doses, attack specific pests. They will evaluate whether plants that make useful compounds could become new, high-value crops for U.S. farmers. They also will assess potential for mass-producing helpful microorganisms, through fermentation on surplus farm crops or on agricultural wastes such as peanut shells. Collectors of the plants and microorganisms will be mainly botanists and ethnobotanists based in South America. They will supply materials having known traditional uses in farming or medicine. Pharmacognetics plans to share profits resulting from the materials with the countries that are the sources.

*ARS Contact: Hank Cutler, Natural Products Utilization Research, Athens, GA, (706) 546-3378*

**...With the Electric Power Research Institute and the U.S. Geological Survey, to develop a global warming computer model.** It will predict effects of climate change on water availability for electricity and other uses such as drinking, irrigation and recreation. New techniques will be developed and incorporated in a USGS modular "shell" along with various existing computer models. The components, such as those for irrigation and hydroelectric power scheduling, can be easily plugged in or removed from the shell. In the project's first phase, scientists will incorporate the ARS Snowmelt Runoff Model, which forecasts the amount of snowmelt runoff each spring. Once this is done, the Electric Power Research Institute can generate climate-change scenarios for power companies in snow regions. The snowmelt model's simplicity eliminates the need to calibrate long-term weather records. ARS also has labs in Arizona and Idaho working with USGS to incorporate the snowmelt and other models. The final product will use projected changes in precipitation and temperature to predict effects on soil moisture and groundwater as well as snowmelt runoff.

*ARS Contact: Albert Rango, Hydrology Lab, Beltsville, MD (301) 504-7490*

...With Gustafson, Inc., of Plano, TX, to develop strains of a fungus that farmers can use to prevent aflatoxin from infesting peanuts. Certain strains of *Aspergillus* fungus produce aflatoxin, which—in a bad year—has cost peanut growers millions in losses. ARS scientists discovered and patented *Aspergillus* strains that do not produce aflatoxin. They found that spreading the harmless fungus in the soil crowds out the aflatoxin-producing strains—serving as a biological control against contamination. Gustafson and ARS will cooperate in field tests to develop ways to mass-produce and deliver the harmless fungi as a commercial product peanut growers can use. (PATENT 5,292,661)

ARS Contact: Richard J. Cole, National Peanut Research Laboratory, Dawson, GA, (912) 995-4481

### Food Safety and Quality

Microwaving and cooking cause greater vitamin loss in meat than does irradiation, according to new ARS research. Consumer groups have voiced concern about irradiation's effect on critical nutrients in food. Researchers tested the effects of gamma radiation on vitamins and nutrient content of chicken and pork chops and found no nutritionally significant losses. The Food and Drug Administration has ruled that radiation-sterilized meats are at least as nutritious as those sterilized by conventional means. ARS researchers earlier had shown that irradiation kills *E. coli* 0157:H7, the bacterium that in 1993 killed four people and sickened 500 others who had eaten contaminated beef. Low doses of irradiation kill food pathogens without leaving any residue or affecting taste or quality of the meat. Costs associated with food-borne illnesses ranged from \$6 billion to \$9 billion in 1993.

Food Safety Research Unit, Philadelphia, PA  
Donald W. Thayer, (215) 233-6582

High-quality apples now reach consumers sooner because of ARS advances in storage techniques. Scientists proved to Washington state officials that Gala and Jonagold apples need be kept only 45 days in controlled atmosphere (CA) storage to meet state requirements. CA apples stay firmer, crisper and tastier than apples stored in traditional cold rooms. Previously, 90-day storage was required. CA storage means low levels of oxygen, high levels of carbon dioxide and cool temperatures. This slows an apple's natural "breathing" rate. CA apples also generate more income for growers. Now the researchers are studying ways to improve the keeping quality of apricots. The fruit currently can't be stored for more than a few weeks, causing a market glut in late summer and low supplies for consumers at other times of the year.

Tree Fruit Research Laboratory, Wenatchee, WA  
Stephen R. Drake, (509) 664-2280

The amount of water a dry bean absorbs, and the rate it absorbs it, may unlock the door to breeding better, faster-cooking beans. ARS studies on 26 genetically diverse, large-seeded, bean cultivars that trace their heritage to the Andes mountain gene pool suggest the water absorption rate could help bean breeders pinpoint new fast-cooking varieties without tedious cooking experiments. Other studies found that storing beans in hot, humid conditions lengthened cooking times and decreased digestibility in some varieties. The experiments, aimed at finding cost-effective and energy-efficient ways to study a genetic trait, may speed the development of new bean varieties that could be cooked with less fuel. Such energy savings could result in greater demand for U.S. beans exported to food- and firewood-deficit countries in eastern and central Africa.

Sugarbeet, Bean and Cereal Research, East Lansing, MI  
George L. Hosfield, (517) 355-0110

The supply of papayas from Hawaii's island of Kauai will soon grace more mainland grocery shelves—and they won't carry any fruit-fly hitchhikers. Using an ARS-developed, forced-hot-air treatment to kill hitchhiking flies, a larger packinghouse owned by the University of Hawaii is scheduled to open in 1996. It will heat papayas to 117 degrees F, then cool them to 86 degrees, to kill any eggs or larvae of Mediterranean and oriental fruit flies or melon flies. This will protect mainland agriculture from these pests that can attack more than 300 crops. Kauai growers today produce about one million pounds of papaya, primarily the premium-quality, orange to pinkish-red fleshed Sunrise variety for out-of-state shipment. The new packinghouse and treatment facility will be able to handle about 11 million pounds a year.

Tropical Fruit and Vegetable Research Laboratory,  
Hilo, HI  
John W. Armstrong, (808) 959-4336

A new sniffing device may give inspectors an opportunity to sample odors of stored grains and oil seeds on a consistent, safe basis. ARS scientists invented the technique to evaluate grains for off-odors that indicate quality problems. The aroma from air passing through the grain is captured by an inspector who evaluates the quality. The technique eliminates smelling odors directly from grain. USDA grain inspectors are testing the prototypes. Inspectors can use the technique to evaluate grain using more consistent criteria standards. Also, the inspectors no longer have to be concerned with inhaling particulate, such as dust, because it gets filtered out. This makes it safer than smelling the grain directly. A commercial manufacturer has shown interest in licensing this patent. (PATENT 5,313,821)

Southern Regional Research Center, New Orleans, LA  
Karen L. Bett, (504) 286-4459/286-4419



## Computer Systems and Models

Gardening and landscaping information for virtually any size and type of yard is available on a new CD-ROM, developed by the National Agricultural Library. NAL's compact disc, called Plant It!, carries nearly 1,000 color images of plants, trees and shrubs—identifying those best suited for different climate zones in the United States. Available commercially for \$80, this disc will run on most IBM-compatible computers with at least four megabyte of memory, a CD-ROM disc drive, and Microsoft Windows. NAL houses thousands of documents related to home gardening and landscaping, a multibillion-dollar industry. For non-USDA orders, contact Dennis Watson, University of Florida, (904) 392-7853, [watson@gnv.ifas.ufl.edu](mailto:watson@gnv.ifas.ufl.edu). USDA employees can contact Dan Starr at NAL, (301) 504-6813, [dstarr@nal.usda.gov](mailto:dstarr@nal.usda.gov).

*National Agricultural Library, Beltsville, MD  
Pam Andre, (301) 504-5248*

Internet users now have access to a database that allows better assessment of the water pollution potential of 230 of the most widely used pesticides. The database includes more than 95 percent of the popular herbicides, fungicides and insecticides used in agriculture. And another 120 pesticides are being added. Farmers, pesticide companies, water resource managers and environmental groups can access the ARS Pesticide Properties Database to gain a better understanding of how and where pesticides may threaten water quality. The data show 16 of the most important chemical, physical and biological characteristics or properties of pesticides. They relate to each pesticide's degradation rate or likelihood of moving into surface or groundwater. For example, a chemical that clings strongly to soil particles is less likely to be washed into groundwater during a rain storm. The database is for use with crop and soil computer models that account for local factors, such as soil texture and temperature, that affect pesticide mobility and longevity. The database is available on the laboratory's World Wide Web home page at <http://www.arsusda.gov>.

*Systems Research Laboratory, Beltsville, MD  
Basil Acock, (301) 504-5827*

## Human Nutrition

Large oral doses of vitamin E or beta carotene do not prevent sunburn or the skin cell damage that leads to photoaging and skin cancer. But preliminary evidence suggests that lycopene—a relative of beta carotene—might help reduce the damage caused by the sun's ultraviolet (UV) rays. In two separate studies, researchers wanted to resolve conflicting evidence that antioxidant vitamins taken orally protect the skin against oxidizing agents generated by the sun's rays. In one study of 12 men and women, small areas of skin were exposed to a burning dose of UV radiation after the volunteers had taken either 400 International Units (IU) of vitamin E or a placebo daily for six months. The supplement did not significantly increase skin levels of vitamin E. And it did not reduce skin redness or cell damage compared to volunteers that got the placebo. In the other study of 16 women, skin levels of vitamin E increased among those who took beta carotene supplements. But this did not prevent sunburn. Skin levels of beta carotene didn't decrease after UV radiation, indicating the nutrient was not being used to protect against sun damage. By contrast, skin levels of lycopene dropped significantly. Researchers could not test the effects of giving extra lycopene, however, because supplements were not available when the study was done. Lycopene is the red pigment that colors tomatoes, watermelons and pink grapefruit.

*USDA Jean Mayer Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Judy D. Ribaya-Mercado/Mohsen Meydani, (617) 556-3128/3126*

When dietary copper was restricted in pregnant and nursing rats, their pups suffered from retarded development of nerve cells in the part of the brain that governs learning and memory. This part of the brain, called the hippocampus, does not finish maturing until after birth and is therefore especially vulnerable to nutrient deficiencies before and after birth. Other studies have shown that the brain requires copper for normal development, but none have specifically investigated if copper was important to nerve cell maturation in the hippocampus. ARS researchers concluded that it is, based on the number and size of neurons in a section of the hippocampus. The degree of retardation in nerve cell development depended on how much copper was removed from the mothers' diets. The next question is whether the developing brain can recover if weaned pups are given adequate copper. Such experiments can't be done on humans for ethical reasons. But it might be prudent for pregnant and nursing mothers to include some high-copper foods in their diets, such as whole

grains, oysters, liver, nuts (particularly Brazil nuts), seeds, cocoa and chocolates. A majority of Americans consume less than the minimum suggested copper intake, which is 1.5 milligrams daily.

*Grand Forks Human Nutrition Research Center, Grand Forks, ND*

*Curtiss D. Hunt, (701) 795-8423*

**A lipid discovered by ARS scientists may join the ranks of drugs that fight inflammation.** Such current nonsteroidal drugs—including aspirin, acetaminophen and ibuprofen—inhibit two biochemical pathways in the body. But, the new lipid, which could be indirectly produced from agricultural products, inhibits only one—the lipoxin biosynthetic pathway. Pharmaceutical companies have been searching for a drug that blocks only the lipoxin pathway. A drug with these properties would work especially well on inflammatory conditions associated with asthma and atherosclerosis. Another plus for the new lipid: It tested negative for fungicidal, herbicidal and insecticidal properties and was nontoxic to several types of cancer and HIV-infected cells.

*Plant Science and Technology Research, Philadelphia, PA*

*Robert A. Moreau, (215) 233-6428*

**Selenium—the essential trace element known for its antioxidant prowess—also appears to lift the spirits,** according to an ARS study. During the 15-week study, 30 men reported significant changes in two of six moods, as measured by a standard questionnaire. The 15 men who consumed nearly 3.5 times the daily recommended selenium intake felt significantly more clear-headed and elated toward the end of the study than they did at the outset. Another 15 men consumed only 40 percent of the recommended intake. Within that group, researchers found differences in all six moods based on the activity of a selenium-containing enzyme in the men's blood platelets. Those with the more active enzymes felt more agreeable than hostile, more clear-headed than confused, more composed than anxious, more confident than unsure, more elated than depressed and more energetic than tired. That's even though enzyme activity was within the "normal" range for all the volunteers. The findings agree with another ARS study in which the amount of selenium in men's red blood cells correlated with two of the mood states. A note of caution: Large doses of selenium can be highly toxic. The World Health Organization recommends a daily limit of 400 micrograms. Good food sources include meat, poultry, seafood, grain products, breads and cereals.

*Grand Forks Human Nutrition Research Center, Grand Forks, ND*

*James G. Penland, (701) 795-8471*

**Long, easy workouts—the kind typically recommended for out-of-condition people who want to lose weight—may also be a good choice for some people of average-or-better fitness.** An ARS study evaluated calorie-burning rates of 32 men who volunteered for workouts on an exercise bicycle. Preliminary results showed that, among 16 men of average fitness, those with more body fat hit their best fat-burning rates when exercising barely hard enough to work up a sweat. Among the other men of average fitness, those with the least stored fat burned it fastest when pedaling harder. Researchers rated the fitness level of each volunteer before he went through increasingly difficult five-minute stints on the bike. The study was one of the first to suggest a correlation between the amount of body fat and men's fat-burning rate.

*Western Human Nutrition Research Center, San Francisco, CA*

*Nancy L. Keim, (415) 556-8821*

**A human virus normally harmless in laboratory mice mutated into a heart-damaging pathogen when the animals were raised on a diet devoid of selenium.** The virus continued to damage hearts, even in mice that later got ample selenium in their feed. The findings are the first indication that a nutritional deficiency can cause a virus to mutate into a more virulent form. And its importance is not limited to nutritionally-deprived populations. ARS researchers supplied the nutritional expertise and diets, and collaborating University of North Carolina researchers provided the coxsackie viruses—there are 29 different types—which infect more than 20 million Americans annually, producing a range of maladies from sore throat and cold symptoms to inflammation of the heart muscle. About 10 percent of infected people develop serious diseases, such as heart muscle inflammation. Other nutritional deficiencies also seem to cause viral mutations. University researchers are now analyzing the genes of another coxsackie virus that damaged hearts in vitamin E-deficient mice. They expect to find the same alterations as with selenium deficiency. Both nutrients serve as antioxidants in the body. If such mutations occur in other RNA viruses, that may help explain the many new strains of influenza virus in China, which has widespread selenium-deficient areas.

*Beltsville Human Nutrition Research Center, Beltsville, MD*

*Orville A. Levander, (301) 504-8504*

*Frank Porter Graham Child Development Center, University of North Carolina, Chapel Hill, NC*  
*Melinda A. Beck, (919) 966-6809*



**Older women had a significant drop in lean body mass, muscle function and the ability to fight off infection** when their protein intake was only about half the recommended level. For a 140-pound woman, the Recommended Dietary Allowance (RDA) is 50 grams per day. While most Americans consume more than enough protein, some 10 to 20 percent of women over age 55 eat less than 30 grams daily. That's about the amount in half a chicken breast, a three-ounce can of tuna or two cups of dried beans. Researchers wanted to see if such a low-protein intake would compromise women's immune responses, as well as their ability to get around and perform normal tasks, even if the women got enough calories. Six volunteers over age 66 ate about half the RDA for protein for nine weeks, while six others got a little more than the RDA. The women getting half the RDA lost an average eight percent of lean tissue, most of which was muscle. One measure of immune response—a hypersensitivity skin test—was 50 percent lower by the end of the study. And the amount of weight they could push in a chest press exercise dropped by 12 percent. By contrast, the six women getting ample protein had no changes in muscle mass. Moreover, several measurements of muscle function and immune response improved significantly as did several blood protein measurements, suggesting that their diet prior to the study may have been a little low in protein.

*Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Carmen Castaneda/Marilyn C. Crim, (617) 556-3142/3095*

**Women who carry a genetic marker for low bone density already have less dense bones in their 20s and 30s than women without the marker.** That's the finding of a study of 155 black and white women age 20 to 40, and it agrees with what has been seen in women past menopause. Because low bone density can lead to osteoporosis, the finding points to the need to identify girls with this marker early in life so that steps can be taken to help them reach their maximal bone density. The marker, discovered last year by Australian scientists, results from a mutation in a gene. This gene makes a protein that regulates the way the body uses calcium. Women with two copies of the marker (one from each parent) had between eight and nine percent less bone density in the hip and 6.4 percent less in the spine than those with only one or no mutation. The study also dispelled the notion that this trait might explain why blacks generally have denser bones than whites. The percentage of black and white women with the genetic marker was about equal. Researchers are

now testing to see if people with the genetic marker are unable to adapt to low-calcium intakes, which are common in the United States. This could help explain their low bone density.

*Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*James C. Fleet, (617) 556-3186*

**Women shaped more like apples than pears may have more difficulty losing weight,** according to weight-loss studies of 22 women. Those with more fat around the waist than the hips and thighs—the apple shape—lost about eight percent of their body weight. That compared to an 18 percent loss in those with larger hips and thighs compared to the waist—the pear shape. Using sophisticated x-ray equipment, the researchers also corroborated what others have observed in larger studies using simpler equipment: Weight loss did not change the waist-to-hip ratio. The women's basic shape remained the same. Since numerous studies have associated the apple shape with a higher risk of cardiovascular disease, diabetes and even cancer, the findings question whether a weight-loss regimen alone will substantially reduce risk. This study combined regular aerobic exercise with a 50-percent calorie cut for optimal weight reduction. Nearly all the weight lost by the women in both groups was in body fat, not in muscle.

*Grand Forks Human Nutrition Research Center, Grand Forks, ND*

*William A. Siders/Henry C. Lukaski, (701) 795-8430/8429*

**Is 200 International Units (IU) of vitamin D—the current Recommended Dietary Allowance (RDA)—enough to minimize bone loss in older women?** The latest study suggests that more is better for protecting the hip—at least in the Northeast where sunshine is sparse during the colder months. Sunlight prompts the skin to manufacture its own vitamin D. During the two-year study of 261 women living in the Boston area, half of the volunteers consumed 200 IU of vitamin D daily, while the other half got 800 IU daily. The group on the higher vitamin D intake lost one percent less bone at the hip during the first year and 0.5 percent less in the second, compared to those getting the RDA. Seventy percent of the benefit occurred in the winter and spring months when the sun's rays are weakest and exposure is infrequent. The women's average vitamin D intake was only half the RDA before the study began. All were given extra calcium during the study to ensure optimal intake. Slowing bone loss at the hip—actually, the top of the thigh bone where it fits into the pelvic girdle—could

spare many elderly people from painful hip fractures. Good sources of vitamin D include fatty fish, egg yolks, and milk—because it is fortified with the vitamin—and fortified breads and cereals.

*USDA Jean Mayer Human Nutrition Research Center  
on Aging at Tufts, Boston, MA  
Bess Dawson-Hughes, (617) 556-3066*

**Black girls absorb calcium more efficiently and form new bone at a faster rate than their white counterparts.** This difference in calcium absorption during childhood and adolescence may explain why black women tend to have lower rates of osteoporosis later in life: They begin with stronger bones. In the study of 89 girls between the ages of five and 16, researchers found the greatest difference in absorption rates after the onset of puberty. But black girls consistently demonstrated more bone-forming activity throughout childhood and adolescence. The finding suggests that recommended intakes of calcium may need to be tailored to particular groups. However, while the black girls absorbed more calcium, none of the girls in the study met the recommended intakes. Current recommendations based on a recent National Institutes of Health panel specify three to four servings of calcium-rich foods for children ages six to 10, increasing to four to five servings at age 11. A serving could be one cup of milk, an eight-ounce container of yogurt or one and a half ounces of natural cheese.

*Children's Nutrition Research Center, Houston, TX  
Steven Abrams, (713) 798-7000*

## IPM/Biological Control

**An ARS-discovered virus that causes sterility in corn earworms** could give farmers an environmentally safe weapon against this scourge of corn, cotton and other crops. Also, the virus may have potential to knock down related pests such as the legume podborer, tobacco budworm and fall armyworm. Together, these pests cause an estimated \$5 billion in damage to various crops throughout the world. Attacking the corn earworm in its moth stage, the virus, called gonad specific virus (GSV), infects only the moth's reproductive system, deforming either ovaries or testes. Most infected moths lack reproductive organs altogether. Based on lab studies, scientists estimate that low levels of the virus cause sterility in 70 to 80 percent of infected moths. The rest become carriers, passing the virus along to the next generation through mating. Scientists discovered the virus in late 1993 in corn

earworms at an ARS laboratory in Stoneville, MS. Field tests of the virus are planned for later this year. ARS has filed a patent application on the virus. (PATENT APPLICATIONS 08/348,175, 08/440,158)

*Insect Neurobiology and Hormone Lab, Beltsville, MD  
Ashok Raina, (301) 504-9396*

**Wood-boring wasps and beetles in the Mid-Atlantic states have a natural enemy**, and now ARS scientists have made it easier to identify this "good" enemy—a family of wasps known as *Aulacidae*. An ARS study collected nearly 800 specimens of the family from 10 sites in Maryland, Virginia and West Virginia. Within this region, 15 of the 30 North American species were found. ARS scientists determined that seasonal flight activity for most species is in late spring and summer, but the peak flight period varies slightly among species. Now a publication gives a key for identifying them and information on each species' hosts and areas where they live. The identification keys and data will be a time-saving reference for biological control specialists and forest entomologists.

*Systematic Entomology Laboratory, Washington, DC  
David R. Smith, (202) 382-1783*

**A strain of the fungus *Aspergillus flavus* that is free of toxin can crowd out strains producing aflatoxin in cotton bolls.** In one ARS test, that action eliminated 99 percent of the aflatoxin from a cotton crop. Aflatoxin-contaminated cottonseed cannot be fed to cattle because the toxin shows up in milk. ARS scientists tested the nontoxic strain (AF36) by applying it to soils planted with cotton in Arizona. In both 1989 and 1990, AF36 displaced infecting strains during cotton boll development. In 1989, 75 to 82 percent and, in 1990, 99 percent less aflatoxin was measured in the cotton crop at maturity. Currently, an experimental-use permit is being sought from the U.S. Environmental Protection Agency for tests on commercial cotton fields. (PATENT 5,294,442)

*Southern Regional Research Center, New Orleans, LA  
Peter Cotty, (504) 286-4391*

**Insect-resistant sugarcane could deliver a knock-out punch to the West Indian cane weevil, the newest adversary of Florida sugarcane.** The weevil, *Metamasius hemipterus*, eludes insecticides because it tunnels inside cane stalks. But ARS scientists have identified eight commercial sugarcane varieties the pest finds unappealing. In field tests, weevils infested more than 20 percent of the stalks of two susceptible varieties—Canal Point (CP) 85-1382 and CP 80-1743. But the newly-identified sugarcane remained weevil-free. ARS scientists began searching for weevil-resistant varieties



shortly after the insect was detected on cane near Lake Okeechobee, FL, in February 1994. Since then, it has attacked the variety CP 85-1382 so severely that growers no longer plant it. The weevil was detected in 1984, and it may have snuck into Miami ports aboard produce shipments. It has not been found in other states.

*Sugarcane Field Station, Canal Point, FL*

*Omelio Sosa, Jr., (407) 924-5227*

## Genetic Resources

**DNA maps are being fashioned by ARS scientists to convict—or free—insects of charges they spread bluetongue in livestock.** This virus disease, carried by biting midges, can cause severe illness in sheep and abortions in cattle. A midge's DNA, however, may reveal that it's unable to spread the disease. That detective work could prove that livestock in the Northeast, where bluetongue has not been reported, can safely be exported to countries free of the disease.

Bluetongue's presence in some U.S. regions now keeps the whole country from competing in livestock markets overseas without the disease. Those markets are valued at nearly \$120 million annually. ARS entomologists are assembling gene maps of different strains of biting midges called *Culicoides variipennis*. Some strains are known to transmit the virus. So far, scientists have identified 12 marker genes to compare midge strains. When the DNA maps are complete, scientists can identify which genes signal that a given strain won't carry the virus.

*Arthropod-borne Animal Diseases Research Laboratory,  
Laramie, WY*

*Walter J. Tabachnick, (307) 766-3605*

**Biotechnology could enable tomorrow's vegetable crops to use a gene from tobacco to ward off viruses.** The gene attacks tobacco mosaic virus that strikes tomato, eggplant, pepper and 150 other species. Scientists with ARS and the University of California at Berkeley isolated and cloned the gene. That's a scientific first for any plant-derived gene for resistance to a plant virus. The researchers placed the gene, called *N*, in a type of tobacco highly susceptible to the virus. The newly fortified plants shrugged off attack. More recently, the scientists slipped *N* into tomato cells to learn whether plants produced from those cells resist the virus. If so, the *N* gene eventually may be moved into other commercial crops. ARS is seeking a patent for the *N* gene. And, with other researchers in the United States

and Australia, ARS has applied for a joint patent for two other, genetically similar plant genes that defend plants against other kinds of microbial attack. (PATENT APPLICATIONS 08/261,633 and 08/310,912)

*ARS/University of California at Berkeley Plant Gene  
Expression Center, Albany, CA*

*Barbara J. Baker, (510) 559-5900*

**ARS scientists and collaborating university researchers have successfully inserted a new gene into Thompson seedless grapes—a scientific first.** They hope the new gene will give built-in protection against a common grape virus. This genetic engineering advance could decrease economic losses for grape growers and reduce the amount of chemicals put into the environment. It paves the way for plant breeders to improve disease and insect resistance of all major grape varieties. Scientists from the University of Florida and Cornell participated in the research.

*Appalachian Fruit Research Station, Kearneysville, WV  
Ralph Scorza, (304) 725-3451*

*Horticultural Crops Research Laboratory, Fresno, CA  
David Ramming/Richard Emershad, (209) 453-3160*

**A search among thousands of alfalfa plants has led to a new alfalfa breeding line that resists a disease-causing fungus.** Plant breeders can use the new line to develop cultivars resistant to the fungus, *Sclerotinia trifoliorum*. *Sclerotinia* causes one of the worst alfalfa diseases in the southeastern and southcentral United States. Severe outbreaks can wipe out entire fields. But no resistant varieties currently are available to farmers who attempt to grow the legume for high-protein forage. To develop the new breeding line, Mississippi Sclerotinia-Resistant (MSR), ARS scientists propagated the most promising candidates, then crossed and evaluated them several times to strengthen resistance in offspring. In greenhouse-grown plants, the researchers found less disease in MSR than in 26 commercial cultivars. In fungus-infected field plots, the new line's yield averaged 83 percent of plots free of *Sclerotinia* disease. Commercial varieties fared much worse, yielding only 38 to 49 percent when infected with the fungus.

*Crop Science Research Laboratory, Mississippi  
State, MS*

*Robert Pratt/Dennis Rowe, (601) 323-2230*

**Hazelnut trees have a new, long-term genetic insurance policy.** Also known as filberts, hazelnuts are popular roasted and in baked goods. Normally, hazelnut seeds won't sprout after long-term storage. But ARS scientists showed that one part of the seeds—the axis, part of the embryo—can survive storage while frozen in

liquid nitrogen. A thawed axis can be grown in tissue culture. That means that the genetic material of the nine primary hazelnut species can be kept indefinitely, and may someday be used to produce new commercial varieties with improved disease or insect pest resistance.

*National Clonal Germplasm Repository, Corvallis, OR  
Barbara M. Reed, (503) 750-8712*

A light switch has been turned off, so to speak, in tropical sorghum plants, so their valuable genes can be bred into varieties growing in the United States and other temperate areas of the world. Tropical sorghum varieties that have key genes for insect and disease resistance could not be grown in temperate areas because days are too long in the summer. Tropical sorghum needs at least 12 hours of darkness to begin producing seed. And if planted during long summer days in the United States, it won't produce seed. Scientists have overcome this problem by genetically "switching off" this sensitivity to day length. After years of breeding tropical and temperate plants, ARS and Texas A&M scientists now have released 50 sorghum germplasm lines that begin to produce seed in temperate areas in 60 to 70 days—regardless of day length. These lines are four to five feet tall, and therefore can be harvested with combines. Normally, tropical varieties can be up to 12 feet tall—too tall for mechanical harvesting. Varieties developed from the new lines will widen the genetic base of sorghum, which is grown on about 13 million acres in the United States at an estimated value of \$1.5 billion. Seed of the new germplasm lines is available to breeders by contacting Texas Agricultural Experiment Station, Route 3 Box 219, Lubbock, TX 79401.

*Tropical Agriculture Research Station, Mayaguez, PR  
Jeffrey Dahlberg, (809) 831-3435*

A biotech "vaccine" that protects peanut plants from deadly viruses could be just around the corner. Virus diseases cost peanut growers an estimated \$10 million a year. ARS scientists for the first time have genetically engineered virus resistance into peanut plants that remain fertile and produce nuts. Until now, genetically engineering peanuts had been unsuccessful because the resulting plants are usually sterile. Scientists injected into peanut cells virus genes that make proteins from the protective coating surrounding the virus. The coat proteins are harmless to the plant, but trigger a reaction similar to a vaccine in humans. The coat proteins alert the plant that an outside organism has invaded, and the plant is then better able to protect itself from the virus. Later this year in greenhouse tests, scientists will grow the seedlings into mature peanut plants, spray viruses on

them and see if the plants continue to be resistant. The researchers injected virus protein genes from two serious virus diseases of U.S. peanuts.

*Plant Genetic Resources Conservation Research,  
Griffin, GA  
Robert Jarret, (404) 228-7303*

## Soil, Water and Air Quality

Can refuse from starch-based plastics be converted into compost for America's farms and gardens? Not until the current biodegradable formulations change. Researchers with ARS and the Rodale Institute in Kutztown, PA, found that only plastic golf tees work. They added the tees along with forks and other starch-based plastics, as well as the pellets used to manufacture them, to a compost pile. After 11 weeks, only the golf tees were indistinguishable from the decayed leaves, used paper plates and poultry litter with which they were composted. All the other items, made with a different plasticizer, failed to decompose sufficiently, even after a year. The researchers concluded that these items had been made with too high a percentage of the wrong type of plasticizer to make acceptable compost for farmers and gardeners. They plan to test other biodegradable formulations as they become available. The work is part of an overall testing of various industrial, urban and rural wastes as possible ingredients in a low-cost commercial compost.

*Soil-Microbial Systems Research Laboratory,  
Beltsville, MD  
Don Kaufman, (610) 683-6383 at the Rodale Institute*

A slightly heavier, but naturally occurring, form of nitrogen acts as a yardstick in identifying the source of nitrate pollution in cave water, springs and streams. Nitrate is a form of nitrogen available to plants. ARS researchers have been measuring the nitrogen form, N-15, in nitrate removed from soil, water and mineral deposits in caves. Tracing nitrate back to its source helps the researchers understand nitrate pollution and recommend solutions to farmers. A year's data confirms earlier studies showing that nitrate with high N-15 levels comes from animal waste, while nitrate with low levels comes from commercial fertilizer. Medium levels come from soil microbes. Also, the first year's data indicate that during the winter, the main source of nitrate pollution is animal waste. Summer's main sources are commercial fertilizer and soil microbes.

*Appalachian Soil and Water Conservation Research  
Laboratory, Beckley, WV  
Doug Boyer, (304) 252-6426*



### **Compost can reduce fertilizer needs by one-third.**

When scientists replaced a third of a nitrogen fertilizer with a blend of composts from sewage sludge and municipal trash, they found that tall fescue grass didn't miss the fertilizer. That's because compost nitrogen is a slow-release form that the grass uses more efficiently with less waste. So grass fertilized with compost took in as much nitrogen as more heavily fertilized grass. An added long-term benefit: The compost continues to supply nitrogen in the following years—half as much as in the previous year. Similar results have been seen in corn grown this summer for a sustainable agriculture demonstration.

*Soil-Microbial Systems Laboratory, Beltsville, MD*

*Larry J. Sikora, (301) 504-9384*

**Mixing shredded newspapers with poultry manure makes soil microbes more active, cutting down on the chance of nitrogen polluting surface and ground water.** The mixture adds carbon, which boosts the activity of soil microbes that trap nitrogen before it washes away. In preliminary studies, ARS scientists filled eight-inch diameter columns with the newspaper/manure mixture above a six-inch hard pan soil, typically found on the southeastern Coastal Plains. Scientists added four grams of nitrogen in two forms—commercial fertilizer and poultry manure—to separate columns. Then they leached water through the column, measuring nitrogen in the water filtering out the bottom. Only two percent of the nitrogen from poultry manure leached out, compared to 25 percent from the commercial fertilizer. Preliminary field studies show that nitrogen losses are reduced by half when newsprint and poultry litter are used instead of commercial nitrogen fertilizer to enrich soil. Scientists are planning more field and lab studies to confirm their findings.

*Coastal Plain Soil, Water and Plant Research Laboratory, Florence, SC*

*Warren J. Busscher, (803) 669-5203*

### **Industrial (Non-Food) Products**

**Automatic, electronic controls, adapted by ARS engineers, that can regulate the speed a cotton roller gin will safely remove cotton fiber from the seed.** As much as \$75 per hour can be saved by increasing overall ginning efficiency by 12 percent. Delicate, extra-long staple cotton will cause clogging if it's fed too fast into the roller gin. That can cause up to \$1200 in damage, as well as downtime, to change the roller. If fed too slow, however, the gin is inefficient, thus raising processing costs. ARS engineers used microprocessors to control

the system, which senses how much electric power a gin stand is drawing. A heavy draw means it's working too hard and may clog. So, the microprocessor steps in to slow the feeding mechanism. ARS engineers used available electronic components to keep assembly costs low and reliability high.

*Southwestern Cotton Ginning Research Laboratory, Mesilla Park, NM*

*Marvis N. Gillum/Sidney E. Hughes, (505) 526-6381*

**An enzyme from soybean hulls is now replacing formaldehyde in industrial products such as adhesives, abrasives and protective coatings.** ARS scientists were first to purify the enzyme and research its properties in the early 1980s, which eventually led to five industry patents. Because the enzyme facilitates the action of oxygen and peroxides on many compounds, it is being marketed for uses ranging from medical diagnostic tests to removal of chlorine-containing pollutants from high-temperature industrial wastewater. Another plus: The purified soybean enzyme, a peroxidase, is more easily isolated than peroxidases from horseradish, now a major source.

*Biopolymer Research, Peoria, IL*

*David J. Sessa, (309) 681-6351*

### **Crop Diseases and Pests**

**A crisp new iceberg lettuce, named Tiber, thrives while other lettuces succumb to tipburn.** Among the top 10 disorders or diseases of American-grown lettuces, tipburn causes inner leaves of vulnerable lettuces to turn brown. After six years of testing, ARS this year offered the dark-green lettuce to seed companies and breeders for planting in Arizona and California. Those states produce 95 percent of the nation's iceberg lettuce. Tiber's name incorporates the "TBR" abbreviation breeders use to designate tipburn resistance. Tipburn occurs when hot weather, too much water or too much fertilizer causes leaves to grow too fast and run out of calcium. Leaf edges killed by tipburn are vulnerable to slime-producing bacteria and fungi that can rot the whole head. Tiber is the offspring of two other ARS lettuces—Salinas and Vanguard 75. Iceberg lettuce is America's second favorite vegetable. •

*U.S. Agricultural Research Station, Salinas, CA*

*Edward J. Ryder, (408) 755-2860*

A new southern pea for gardeners and farmers fights off damaging nematodes, insects and diseases. Now available to seed producers, the new variety, Tender Cream, is ideal for southeastern states, where it also gets high grades as a canned pea. It produced 18 percent more peas than the top commercial varieties during 1994 region-wide field tests. Its pods are slightly curved, about six inches long, and contain about 14 peas. In the field tests, it had 75 to 98 percent fewer cowpea curculio larvae than susceptible varieties. Tender Cream also had 22 percent higher yields than a similar variety that was susceptible to root-knot nematodes. The variety also has resistance to blackeye cowpea and southern bean mosaic viruses, as well as other diseases. Limited amounts of seed are available to certified seed producers and to breeders.

*U.S. Vegetable Laboratory, Charleston, SC  
Richard L. Fery, (803) 556-0840*

A new soybean breeding line resists the fungal disease Sudden Death Syndrome (SDS), soybean cyst nematodes and two species of root knot nematodes. Developed by ARS and Mississippi State University researchers, the new line D83-3349 is available to public and private soybean breeders. Because of its multiple pest resistance, D83-3349 is a promising parent for new soybean varieties in the Midsouth where soybean cyst nematode and SDS are serious problems. Seeds for research breeding may be obtained from the Soybean Production Research Laboratory, P.O. Box 196, Stoneville, MS 38776.

*Soybean Production Research, Stoneville, MS  
Edgar E. Hartwig, (601) 686-3126*

DNA probes can quickly unmask the fungal pathogen that causes Sudden Death Syndrome (SDS) in soybean fields. Diagnosis comes in less than 24 hours, compared with up to four weeks for standard methods. SDS affects soybeans in Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Missouri, Mississippi, Tennessee, Texas and Wisconsin. Developed by ARS researchers, the DNA probes are based on computerized genetic information from all species of *Fusarium*, including the SDS culprit. In laboratory tests, the probes accurately identified the SDS pathogen from other isolates of *Fusarium* and from infected plants.

*Microbial Properties Research, Peoria, IL  
Kerry O'Donnell, (309) 681-6383*

## Crop Productivity

Strawberry production can be increased tenfold in the greenhouse using a new hydroponic technique that relies on wastewater from trout production. First, solids are screened from the wastewater, which then flows down vertical plastic tubing. The nutrient-rich water bathes the roots of strawberry plants growing from "elbows" in the tubing. In four square feet of greenhouse space, 24 plants are grown hydroponically where only two can be grown under conventional practices. The system produces good-sized fruit that are just as tasty as strawberries grown in the field. In the process, the plants clean the wastewater. And the solids are used to make a new potting mix. Hydroponic growers could fill the market gap between October and December with these strawberries. California strawberries end in October; Florida starts shipping around Christmas.

*Appalachian Fruit Research Laboratory,  
Kearneysville, WV  
Fumiomi Takeda, (304) 725-3451*

Ultra, a newly released hop variety, could help U.S. specialty brewers produce a more aromatic, European-style beer. These qualities usually come from European hops, which often aren't available to microbrewers at an affordable price. In field tests, Ultra produced twice the yield as its European counterparts. Ultra is grown commercially in Washington and is available from the hop trade. Ultra is the fourth European-style aroma hop released by ARS since 1989. Like the others—Mt. Hood, Liberty and Crystal—Ultra descends primarily from the old German aroma hop Hallertauer mittelfrueh. Idaho, Oregon and Washington are the prime hop-growing states.

*Forage Seed and Hop Research, Corvallis, OR  
Alfred Haunold, (503) 750-5841*

Some desert shrubs survive because their roots make a U-turn to find water. In humid areas, roots searching for water usually continue growing downward. But ARS scientists found that roots of some desert shrubs make an about-face at depths of one to several feet. Then they grow upwards, branching near the surface to capture moisture from scarce rainfall. Scientists are uncovering these and other secrets of desert plants, including the relationship of fungi to plants. This part of the desert ecosystem has not been extensively studied until recently. Improved understanding of its natural processes helps scientists gauge the capacity of desert rangeland to support wild and domestic grazing animals.

*Rangeland Management Research, Las Cruces, NM  
Robert Gibbens, (505) 646-4842*



**Farmers in northeastern Colorado can make up to 35 percent more money by adding a summer crop instead of alternating years of winter wheat and fallow.** A summer crop gives farmers a three-year rotation that could include corn, proso millet or sorghum after wheat and before the fallow year. Farmers had been wary about making this change until ARS scientists demonstrated that the region's rainfall usually is adequate to grow the extra money-producing crop. While that's not possible in the southern part of Colorado, acres of rain-fed corn in northeast Colorado have nearly quadrupled since the mid-1980s. Farmers using the new rotations produce more soil-holding stalks and other crop residue required by USDA farm programs. Traditional wheat/fallow cropping over the past 60 years caused extensive wind and water erosion.

*Central Great Plains Research Station, Akron, CO  
Randy L. Anderson, (970) 345-2259*

**Balloon flowers, originally grown as cut flowers from root stock, can be grown from seed as potted plants.** Visiting Korean scientists and ARS researchers studied the influence sowing time, temperature and type of flower cultivars had on the growth and flowering of five balloon flower cultivars. They found that plants flowered best under a day/night temperature of 70/65 degrees F. The plants produced flowers under any length of daylight, but produced more flowers when given 16 hours of daylight. The plants also produced more flowers and shoots when extra lighting or more daylight was added. Of the five cultivars studied, Sentimental Blue flowered the earliest, in less than 149 days, under a day/night temperature of 65/60 degrees F. As temperatures increased to 80/75 degrees F, the number of shoots, leaves and flowers increased. Sentimental Blue is an ideal cultivar for potted plant production and can be forced from seeds in just 140 days.

*Floral and Nursery Plants Research Unit, Beltsville, MD  
Mark Roh, (301) 504-5659*

**An acre of Myles desi chickpeas, a new variety from ARS, can produce up to 2,000 pounds of chickpeas,** compared to 1,000 to 1,500 pounds for other varieties. Chickpeas, also known as garbanzos, are low in fat and rich in protein, complex carbohydrates and fiber. Popular Indian, Pakistani and Ethiopian dishes use desi chickpeas. They're smaller and darker than cream-colored kabuli chickpeas found in salad bars. Myles also has resistance to blight-causing fungi—an essential insurance for Pacific Northwest growers. Several years ago, Aschochyta blight fungus devastated the region's chickpeas—desi and kabuli alike. The industry began

climbing back on its feet after ARS released Sarah, the first blight-resistant desi in 1990 and Dwelley and Sanford, the first resistant kabulis, in 1993.

*Grain Legume Genetics Physiology Research,  
Pullman, WA  
Frederick Muehlbauer, (509) 335-9521*

## Animal Diseases and Pests

**A gene that mutates rapidly and continually can turn relatively weak strains of avian influenza (AI) virus into poultry-killing strains.** In 1983, more than 17 million chickens were slaughtered to halt a severe U.S. outbreak caused by such a mutation. Last year, a virulent, highly contagious strain began killing Mexican poultry. In several isolates of Mexican AI, ARS scientists found the mutant gene. This new genetic clue to AI's severity may open the way to predicting which strains are likely to become poultry killers, just as health agencies routinely predict severe strains of human influenza. ARS scientists found that AI virus uses a genetic mutation mechanism similar to that of the human flu. The key AI gene controls the shape of a molecule called hemagglutinin, or HA. A relatively weak AI virus binds only to respiratory tract or gut cells. With an HA molecule that has mutated to take on the "right" shape, the virus also attacks cells of other organs, especially the brain and heart, causing fatal results.

*Southeast Poultry Research Lab, Athens, GA  
Michael L. Perdue/David E. Swayne, (706) 546-3435*

**A virus that kills unborn and newborn pigs may lurk in the lungs of carrier pigs even when the virus isn't detectable in the pig's blood or other tissues.** Free-floating, infection-fighting cells in pigs' lungs often can carry porcine reproductive and respiratory syndrome (PRRS) virus. ARS researchers flushed out these cells, called alveolar macrophages, and in laboratory tests were able to identify the virus in them when other tissues in the pig apparently were virus-free. Quick identification of this virus can help cut pork producers' losses that may range as high as \$250 per sow. Pigs can be long-term carriers of the virus without showing signs of disease.

*National Animal Disease Center, Ames, IA  
William L. Mengeling, (515) 239-8254*

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A toxin made by fungi that can infect corn disrupts a essential fat in mammals. This discovery by ARS and Emory University scientists may lead to reducing the disease threat posed by the toxin, called fumonisin. Five years ago, scientists learned that high levels of fumonisin are the direct cause of rare outbreaks of disease in farm animals. The outbreaks had long been tied to animal feed, such as broken corn kernels called screenings, infected with *Fusarium* fungi. Several dozen horses in Kentucky and Virginia died earlier this year after eating *Fusarium*-tainted screenings. Scientists elsewhere have linked fumonisin to higher rates of cancer of the esophagus in people in areas of southern Africa and China. Now, the ARS and university researchers have established a link between fumonisin and fats known as sphingolipids. These fats occur in plant and animals, mainly in cell membranes. In studies with cells, farm animals and plants, the researchers found that high levels of fumonisin halted the making of sphingolipids. Instead, one of the fat's building blocks—a molecule called sphinganine—grew to extraordinarily high levels. Also, rates of cell division became either abnormally slow or rapid. These changes often are early signs of disease. Little is known about the dietary role or biological function of sphingolipids. But the new findings suggest they are important for plant and animal health.

*Toxicology and Mycotoxin Research, Athens, GA*  
Ronald Riley/Kenneth Voss, (706) 546-3377

Pork producers should check the label before relying on a vaccine to protect their pigs against *Atrophic rhinitis*, a respiratory tract disease. ARS studies recently confirmed the effectiveness of commercial vaccines made with a denatured *Pasteurella multocida* toxin called a toxoid. Not all vaccines against *Atrophic rhinitis* are made with a toxoid. In tests, pigs vaccinated against *Atrophic rhinitis* gained weight normally and didn't develop nasal or bone deformities that are a telltale sign of the disease. *Atrophic rhinitis* costs pork producers about \$4 million annually in vaccine medications, reduced weight gains and deaths.

*National Animal Disease Center, Ames, IA*  
Mark R. Ackermann, (515) 239-8221



**Specific pituitary gland cells in turkeys may be hidden culprits behind some birds' reluctance to lay eggs.** That's because these cells, called somatotrophs and normally tied to production of growth hormone, can switch function to make a hormone called prolactin. Turkeys with high levels of prolactin become "broody," preferring to try to sit and hatch eggs rather than producing more. Broodiness seriously cuts into turkey egg production that's already comparatively low, averaging only about 90 eggs over a scant 25-week laying season. It's been estimated that boosting turkey egg turnout by just 10 eggs per hen could increase turkey industry income by some \$30 million. Researchers are using the new information about changing cell function to search for various ways to stop excess prolactin production.

*Germplasm and Gamete Physiology Laboratory,  
Beltsville, MD*

*John A. Proudman, (301) 504-8094*

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# Quarterly Report

of Selected Research Projects

July 1 to September 30, 1995

United States  
Department of  
Agriculture

Agricultural  
Research  
Service



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## Into the Marketplace

A cayenne pepper that sent a laboratory into overdrive to fill 28,000 requests for seed has sped to the market in two years. Charleston Hot, released in early 1993, made its dinner table debut this year in two new hot sauces—Holy City Heat, made by Atlantis Coastal Foods, in Charleston, SC, and Charleston Hell Hot Sauce, made by Three Amigos restaurants. Also, at least nine outlets are selling Charleston Hot seed: DeGiorgi Seed Co., Omaha, NE; Jones Deade, Charleston; Pepper Joe's, Inc., Norristown, PA; Pepper Gal, Ft. Lauderdale, FL; R.H. Shumways, Graniteville, SC; R.H. Shumway's Totally Tomatoes, Augusta, GA; Rupp Seeds, Wauseon, OH; South Carolina Foundation Seed Association, Clemson, SC; and Nanjemoy Flower & Herb Farm, Nanjemoy, MD.

*U.S. Vegetable Laboratory, Charleston, SC  
Philip D. Dukes/Richard L. Fery, (803) 556-0840*

Scientists are listed for further information on each research project. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723/2824, [sadams@asrr.arsusda.gov](mailto:sadams@asrr.arsusda.gov) or [lspurloc@asrr.arsusda.gov](mailto:lspurloc@asrr.arsusda.gov)

Items marked with the word PATENT are being patented by ARS. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 416, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a company's product and/or research should be directed to the company itself.

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## Patent Licenses

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AG Libran  
...To Applied Separations, Allentown, PA, to commercialize a machine that removes fats, chemical residues and other compounds from food products. It's a multipurpose Supercritical Fluid Extractor (SFE), developed jointly with ARS scientists under a cooperative research and development agreement. The machine uses carbon dioxide, a harmless gas, instead of toxic organic solvents to extract materials. The Environmental Protection Agency has mandated that use of these organic solvents be reduced or eliminated because of their harmful environmental effects. Other uses for SFE, besides removing fats, include extracting residues of herbicides and pesticides from grains and meats, and removing trace antibiotics, nitrosamines and hormones from meat. Applied Separations will also do pilot tests of SFE for industrial uses such as separating dyes, essential oils and pharmaceuticals from plants and trace-level cleaning of delicate electronic components. (PATENT APPLICATION 08/106,681)

*ARS Contact: Robert J. Maxwell, Food Safety  
Research Unit, Philadelphia, PA, (215) 233-6433*

## Cooperative Research and Development Agreements

...With B.C. Cotton of Bakersfield, CA, to develop and evaluate yarns and fabrics containing naturally colored cotton fibers. These fibers are typically too short and weak for routine processing on conventional textile machines unless blended with white cotton, which reduces color intensity. ARS researchers are using certain proprietary spinning methods to overcome these limitations while obtaining superior physical and aesthetic properties in the resulting textiles. These include richer, more intense colors, improved yarn strength and resilience. The resulting fabrics are generating considerable market interest, heightened by their ecological benefit and possible cost advantage by not requiring chemical dyeing. Ongoing research is exploring and characterizing the physical and aesthetic attributes of these fabrics.

*ARS Contact: Linda B. Kimmel, Southern Regional  
Research Center, New Orleans, LA, (504) 286-4335*

...With Tascon, Inc., of Houston, TX, to develop a recycled potting mix from waste paper compressed into pellets and mixed with poultry litter or other



manures. The waste paper, such as newspapers and telephone books, retains water. The manure acts as a slow-release fertilizer. Also, ARS scientists are conducting tests to see if the waste paper pellets can be used as bedding in poultry houses before being recycled into a potting mix. In trials, farmers have noted that bedding made from broken pieces of paper pellets absorbs urine better and keeps dust down better than sawdust, wood shavings, peanut hulls and other commonly used bedding material.

*ARS Contact: J.H. Edwards, Jr., Soil Dynamics Research, Auburn, AL, (334) 844-3979*

**...With Rogers Seed Co., Nampa, ID, to transfer corn earworm resistance from field to sweet corn.** This pest costs U.S. growers more than \$100 million in losses each year. Growers often have to spray pesticides 25 to 40 times onto sweet corn headed for fresh market sale. Otherwise, the worms will burrow into corn ears and feed on the kernels. But ARS scientists have discovered certain field corn lines—normally grown for animal feed—that have silks with genetic, chemical resistance to the pests and require little spraying. Scientists will use breeding techniques to transfer the field corn resistance to Rogers' sweet corn lines. An earworm-resistant sweet corn could cut pesticide spraying by up to 85 percent, reducing production costs and helping the environment.

*ARS Contact: Neil Widstrom, Insect Biology and Population Management Research Lab, Tifton, GA, (912) 387-2341*

**...With International Flora Technologies, Ltd., of Apache Junction, AZ, to develop cosmetic and personal care products from lesquerella.** This semi-arid crop, suited to southwestern states, is a source of oil and fatty acids similar to castor oil. The United States currently imports castor oil from foreign countries. ARS will prepare derivatives from lesquerella oil and its fatty acids. International Flora will develop applications for the cosmetic and personal care industry.

*ARS Contact: Thomas Abbott, New Crops Research, Peoria, IL, (309) 685-4011*

**...With Monsanto Agricultural Company of St. Louis, MO, to evaluate the commercial potential of genetically arming cotton plants to fight off bollworms, tobacco budworms and other caterpillar pests.** If the plants pass muster on cotton yield, lint quality and other traits, growers could get a new alternative to insecticides. Caterpillars cost cotton growers millions of dollars annually in chemical controls and lost yield. Monsanto scientists armed cotton plants with pest-fighting genes from the natural soil bacterium *Bacillus thuringiensis*, or Bt. These genes produce proteins that

cause caterpillars to stop feeding on the plants and eventually starve. ARS scientists earlier tested plants having one Bt gene. But this CRADA calls for testing plants carrying two Bt genes as a possible way to curb insect resistance to Bt. Also, scientists are investigating a second resistance-delaying tactic—mixed plantings of Bt and non-Bt cotton.

*ARS Contact: Johnie N. Jenkins, Crop Science Research Laboratory, Mississippi State, MS, (601) 323-2230*

**...With Mycotech Corp. of Butte, MT, to fine-tune production techniques and conduct field trials on a new environmentally friendly fungal agent that kills the sweetpotato whitefly, also known as the silverleaf whitefly.** An ARS fermentation process will be used to produce quantities of the fungal agent. The sweetpotato whitefly attacks more than 600 plants worldwide including cotton, ornamentals, vegetables, cole crops and melons. Crop losses in California, Florida and Texas alone exceed \$250 million annually. This CRADA marks the 500th such agreement between ARS and industry since the Federal Technology Transfer Act of 1986.

*ARS Contact: Mark A. Jackson, Fermentation Research, Peoria, IL, (309) 681-6283*

**...With SunRise Software, Inc., of Hancock, MN, to develop a farm-scale production records, inventory and decision-aid system called FarmWin.** FarmWin software will provide records of past farm operations such as crops planted, tillage used, yields, expenses and income. It will also predict outcomes of alternate management decisions, helping farmers compare the agronomic, environmental and economic benefits. This system is based on earlier prototype versions of ARS-developed FARMBOOK software tested by farmers. FARMBOOK concentrated on providing basic record-keeping, including types of vehicles and fuel usage. ARS scientists are working with farm managers, agricultural and software specialists to develop FarmWin.

*ARS Contact: R. Samuel Alessi, North Central Soil Conservation Research Laboratory, Morris, MN, (612) 589-3411*

## Food Safety and Quality

**Purified extracts of vanilla, cinnamon, almond and pepper are being used to fight foodborne bacteria.** ARS researchers tested several other natural compounds extracted from asparagus, carrots, radishes, shallots and turnips, as well as combinations of these compounds against several food pathogens. They got best results with the simplest compound tested—benzaldehyde,



which is found in peaches. Combined with heat, these compounds slow down, and in some cases stop, bacterial growth. When commercially available, meat processors could use these compounds as antimicrobial sprays or dips to increase the microbiological safety and shelf life of their products. Also, the compounds could lessen the amount of time processed foods must be cooked, increasing their quality. (PATENT APPLICATION 08/242,896)

*Microbial Food Safety Research Unit,  
Philadelphia, PA  
Arthur J. Miller, (215) 233-6676*

**Milkfat encapsulated in all-purpose flour could be a new alternative to conventional shortening in cakes, pie crusts and other baked goods.** Such uses could provide a new market for surplus butter. ARS scientists made the spray-dried, free-flowing butter powder from butter oil, nonfat dry milk and other food ingredients. In lab tests, the butter powder worked well in biscuits, cookies and muffins. Another plus: The new mixture doesn't require refrigeration. Encapsulated milkfat is better than shortening in blending with other dry ingredients, storage and taste.

*Dairy Products Research Unit, Philadelphia, PA  
Virginia H. Holsinger, (215) 233-6703*

**Spray calcium on apple and pear trees and harvest juicier, higher-quality fruit.** That was the original finding of ARS researchers 18 years ago. Now, they report that nearly all growers in the Pacific Northwest use calcium as a way to protect orchards against fruit damage and harsh winters. An added payoff for consumers: Trees produce fruit that's about 10 percent higher in dietary calcium. Sprays of calcium chloride or calcium nitrate reduce damage from bitter pit, scald and internal breakdown. If left unchecked, these three disorders can render fruit unmarketable, leading to millions of dollars in losses. Also, the sprays help protect trees from extreme winter cold that can stunt next year's growth and reduce yield. Calcium sprays are applied at three-week intervals from June through August.

*Tree Fruit Research Laboratory, Wenatchee, WA  
Stephen R. Drake, (509) 664-2280*

**A new test will allow peanut producers to tell which nuts are of the highest quality.** The new test produces a red color to indicate which peanuts have reached the highest stage of maturity. It detects the amount of the enzyme alcohol dehydrogenase, which increases as the peanut matures. Mature peanuts have better taste and have improved shelf life. This test correlates well with the shell color maturity test. That is, the darker a peanut shell, the more mature the nut is. If producers can

separate their peanuts by maturity level, they can isolate high quality nuts for superior products.

*Food Flavor Quality Research, New Orleans, LA  
Si Yin Chung, (504) 286-4465*

**Jasmine flowers smell sweet thanks to natural compounds that could save millions of dollars worth of stored potatoes from premature sprouting.** ARS scientists treated potatoes with either standard applications of a synthetic chemical called CIPC—the only commercially available sprout inhibitor for stored potatoes—or much smaller amounts of the jasmine compounds, called jasmonates. Sprouting was delayed for several months equally well in both cases. When potatoes sprout in storage, they soften and lose weight, leading to losses in marketability. Also, the raw spuds change much of their starch into sugars during long-term storage, resulting in unattractive brown and off-flavored potato chips. Treating potatoes with jasmonates to naturally control sprouting has the added benefit of lightening color of the processed chips. (PATENT 5,436,226)

*Potato Handling, Storage and Processing Research,  
East Grand Forks, MN  
Edward C. Lulai, (218) 773-2473*

**Yeast that grows on low-value corn residues from ethanol production could be a new alternative way to give farm-raised salmon the pinkish tint consumers desire.** What makes that possible in the yeast, *Phaffia rhodozyma*, is astaxanthin, the same natural, color-producing compound that puts the pink in the flesh of mountain trout. Astaxanthin is naturally present in mountain streams. Aquaculturists now rely on an expensive feed ingredient—shrimp byproduct meal—to put pink coloring in fish raised in ponds. ARS scientists have identified thin stillage and corn-condensed distiller's solubles as two of the most promising ethanol byproducts upon which to grow *Phaffia*. Feeding fish whole *Phaffia* would require approval by the U.S. Food and Drug Administration. Last spring FDA approved use of up to 80 milligrams of astaxanthin per kilogram of salmon feed.

*Biopolymer Research, Peoria, IL  
Timothy D. Leathers, (309) 681-6377*

## Human Nutrition

**One-in-three girls and one-in-four boys had body fat levels considered obese for adults, according to a study of more than 600 children and teens living in the Houston area.** That's a big jump from 20 years ago when only one-in-six girls and boys exceeded the obesity threshold for adults—32 percent fat for women and 25

percent fat for men. The study, still ongoing, also found differences among white, black and Hispanic youths. Hispanic youths had the highest average body fat—32 percent for girls and 24 percent for boys. White girls had the lowest average body fat—26 percent—among the females. And black boys averaged the lowest—19 percent—among the males. All subjects were measured by two highly accurate methods for assessing body composition: dual energy x-ray absorptiometry (DEXA) and emissions of potassium-40, a radioactive form of the element occurring naturally in the body in tiny amounts. This is the only study worldwide to assess fat and lean composition of children in different ethnic and racial groups. When complete, it should produce data on 1,000 children—enough for developing charts that show normal ranges of body composition similar to the height and weight growth charts in pediatricians' offices.

*Children's Nutrition Research Center, Houston, TX  
Kenneth J. Ellis, (713) 798-7132*

**Black children start their growth spurt two to five years earlier than white or Hispanic children.** This finding from a study of more than 600 children and teens points to the need to customize dietary recommendations for different ethnic groups to provide the protein and minerals for children when they need them. Black girls and boys tend to grow taller and heavier and mature faster than white or Hispanic children. At age 6, black girls begin adding significantly more muscle and bone than white or Hispanic girls, while these two groups wait until around age eight or nine for their growth spurt. Black boys begin to outpace white and Hispanic boys at age seven and grow even faster at age 12, when white and Hispanic boys are beginning their growth spurts. Current data on changes in body composition—fat, muscle and bone—during childhood were developed from data gathered in the 1950s, 60s and 70s on white children only. And they only give an average value for different ages. This ongoing study of boys and girls ages three to 18 aims to develop body composition charts showing the range of normal growth patterns among the major ethnic groups in this country. It shows that today's youths are bigger and taller than those of three to four decades ago along with having more body fat.

*Children's Nutrition Research Center, Houston, TX  
Kenneth J. Ellis, (713) 798-7132*

**Black adolescent girls had lower aerobic capacity than their white counterparts during a treadmill test, even though both ethnic groups had the same amount of body fat.** Researchers conducted the study of 93 girls, ages 11 to 16, because of scanty information on the

physical fitness of U.S. adolescents of different ethnic origins. Researchers measured peak oxygen consumption—an indicator of fitness known as  $VO_{2max}$ —in 40 black girls and 53 white girls while they ran on a treadmill to the point of exhaustion. The black girls consumed 17 percent less oxygen than the white girls during the test and reached exhaustion nearly a minute earlier—8.5 versus 9.4 minutes. Blood tests showed that hemoglobin—the oxygen-carrying molecule in red blood cells—was six percent lower in the black girls. Studies done in other countries suggest that ethnicity contributes to differences in aerobic fitness. Researchers don't yet have an explanation but suspect both genetics and lifestyle contribute to the differences. They are currently analyzing data they collected on the girls' body composition and resting metabolic rate for clues.

*Children's Nutrition Research Center, Houston, TX  
William W. Wong, (713) 798-7168  
James M. Pivarnik (formerly ARS), (517) 353-3520*

**Older people's need for dietary protein markedly differed in two studies—indicating that more and larger studies are needed to resolve the question of protein requirements after age 50.** A two-week study of 12 men and women in their late fifties, sixties and seventies suggests that the recommended dietary protein allowance (RDA) for people over age 50 may need to be adjusted upwards to 1.0 to 1.25 grams per kilogram of body weight each day (g/kg/d). The current RDA—0.8 g/kg/d—is the same as for younger adults, because the data on older people has been too scanty to establish a separate requirement. In this study, conducted at the ARS center in Boston, researchers calculated the amount of protein volunteers needed, using a formula adopted by the World Health Organization (WHO) in 1985. On average, the volunteers required a little more than the current RDA—about 1.0 g/kg/d—just to replace the protein they excreted daily. The researchers also recalculated protein requirements for three earlier studies using the newer WHO formula and got nearly the same estimate—an average of 0.9 g/kg/d. Their suggested 1.0 to 1.25 g/kg/d would cover those who require more than average. By contrast, all 14 women in a seven-week study stayed in balance while getting the RDA, suggesting that 0.8 g/kg/day is adequate. The women were between 51 and 70 years old. Conducted at the ARS center in Grand Forks, ND, this study differed from the Boston study in several ways. Most importantly, these diets provided more calories per kilogram of body weight. When calorie intake is too low to maintain body weight, people will burn protein to supply energy and thus appear to need more than they actually do to



renew tissues. Larger studies need to be done to resolve the question of protein requirements after age 50.

*Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Wayne W. Campbell (formerly ARS), (814) 865-3453*

*Grand Forks Human Nutrition Research Center,*

*Grand Forks, ND*

*Janet Hunt, (701) 795-8328*

**Vitamin E, vitamin A and two other antioxidants—lutein and zeaxanthin—have been found in the eyes' lenses, suggesting they may help protect against the formation of cataracts.** Analyzing both healthy and cataract-clouded human lenses removed during surgery, researchers found significant levels of vitamins E and A, lutein and zeaxanthin. These latter two compounds are carotenoids—plant pigments related to beta carotene—and are abundant in yellow and dark green leafy vegetables, such as spinach, broccoli and kale. No other carotenoids, including beta carotene and lycopene—two major carotenoids in human blood—were found in the lenses. Population studies have shown a relationship between carotenoid or vitamin A levels in the blood and a lower incidence of cataracts. Of the 31 lenses analyzed, those removed from Asian Indians, who traditionally eat a lot of vegetables, had significantly higher levels of the antioxidants than those from Americans. Among the American lenses, antioxidant levels differed significantly, possibly reflecting a wide difference in vegetable intake among Americans.

*Jean Mayer Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Kyung-Jin Yeum, (617) 556-3128*

**Obstetricians may someday monitor pregnant women's water weight gains using harmless electrical current.** A study by scientists with ARS and the University of California at Berkeley may be the first to explore this specialized use of a technique known as bioimpedance spectroscopy, or BIS. During pregnancy, water accounts for most weight gain. But water buildup outside cells—extracellular water—can lead to edema for the mother-to-be. This sometimes painful swelling can raise blood pressure and cause other complications. In tests of 10 pregnant women, aged 20 to 37, the researchers found that BIS is faster and easier than options that require drinking or injecting fluid containing a tracer. A BIS measurement also is just as accurate, takes only two minutes and requires no blood samples, unlike tracer methods. BIS sends a harmless sweep of electricity through electrodes at the hand and foot. It distinguishes differences in resistance, as the electricity travels easily through water or is impeded by cell membranes. A computer converts these measurements into estimates of total water in the body, and water

outside and inside cells. Xitron Technologies, Inc., San Diego, developers of the BIS instrument used in the experiment, collaborated with ARS in the study.

*Western Human Nutrition Research Center, San Francisco, CA*

*Marta D. Van Loan, (415) 556-5729*

*Children's Nutrition Research Center, Houston, TX*

*William W. Wong, (713) 798-7168*

**A daily dose of the blue-green algae Spirulina may help prevent cancer of the mouth, a study shows.** The finding could benefit people in developing countries where the algae is cheaper than vitamins. After one year of consuming only one gram of the algae daily, 45 percent of the volunteers had complete regression of the thick, white, pre-cancerous patches in the mouth known as leukoplakia. Taking in to account those volunteers who showed significant improvement raised the figure to 57 percent who benefitted from Spirulina. That compared to seven percent of those who got a placebo. The study—the first human evaluation of the cancer-preventive potential of Spirulina—was coordinated by an ARS researcher and conducted in southwestern India where the incidence of leukoplakia is high. The researchers tested Spirulina because it is an inexpensive source of beta carotene and related carotenoids in many developing countries. In other research, the algae has inhibited oral cancer in animal studies, while beta carotene or vitamin A supplements have reversed pre-cancerous conditions in people's mouths. Cancer of the mouth and of the cervix—which has the same kind of mucus membrane—is on the rise worldwide.

*Beltsville Human Nutrition Research Center, Beltsville, MD*

*Padmanabhan P. Nair, (301) 504-8145*

**Measuring blood levels of the amino acid homocysteine only after an overnight fast could miss nearly half of the people with elevated levels.** Research has linked high homocysteine levels to increased risk of heart disease and stroke. A second measurement—taken after a dose of another amino acid, methionine—is needed to identify all cases, according to a study of 247 volunteers. That's because some people have a low tolerance for methionine and convert it rapidly to homocysteine, which raises blood levels. High blood levels of homocysteine may be damaging to arteries. Researchers found that the test done after overnight fasting failed to identify nearly half of the high-homocysteine cases. These cases were detected only after volunteers got a dose of methionine. Both tests are needed because three vitamins are involved in homocysteine metabolism. The overnight fast test reveals those people with folate (folic acid) or vitamin B<sub>12</sub> deficiency, while the methionine test detects people

who lack vitamin B<sub>6</sub>. Also, researchers streamlined the second test so homocysteine can be measured two hours after a dose of methionine instead of four or six hours.

*Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA*

*Andrew G. Bostom/Jacob Selhub, (617) 556-3356/3191*

**People don't need to become severely deficient in magnesium for the brain to become hyperactive.** A new study confirms earlier reports that a marginal magnesium intake overexcites the brain's neurons and results in less coherence—creating cacophony rather than symphony—according to electroencephalogram (EEG) measurements. Thirteen women consumed 115 milligrams of magnesium per day (mg/d)—or about 40 percent of the Recommended Dietary Allowance—for half of the six-month study. During the other half, they got 315 mg/d—a little more than the 280 mg/d recommended intake for women. After only six weeks on the marginal intake, EEG readings showed significant differences in brain function. Magnesium is the fourth most abundant element in the brain and is essential in regulating central nervous system excitability. Clinical studies of people severely deficient in this essential element have reported epilepsy-type convulsions, dizziness and muscle tremors or twitching, as well as many psychological symptoms, including irritability, anxiety, confusion, depression, apathy, loss of appetite and insomnia. While the marginal intake in this study did not produce such severe symptoms, it did hype brain activity. This is the first experimental study in which magnesium intakes were tightly controlled and EEG measurements were analyzed by computer so that they could be statistically compared. Good sources of magnesium include whole grains, nuts, peanut butter, cottonseed, peanut and soybean flours, green leafy vegetables and spices.

*Grand Forks Human Nutrition Research Center, Grand Forks, ND*

*James G. Penland, (701) 795-8471*

## Animal Productivity

**A new ranking system identifies the total financial worth of milk-producing cows in a dairy herd.** Dairy producers can use the rankings in making breeding decisions for peak milk production and profits. Originally, the system was developed by ARS scientists for evaluating dairy bulls. Known as Net Merit, the new system is based on the economic value of a dairy cow's genetics—its milk quality, productive lifespan and resistance to mastitis, a dairy cow disease. It goes beyond the practice of measuring common pounds of milk a year as a yardstick for a cow's performance. A report of the

ranking data, updated twice a year, is available to producers nationwide. It's also part of commercially available computer databases. Net Merit rankings also help farmers pick animals to sell to artificial insemination and embryo transfer services.

*Animal Improvement Laboratory, Beltsville, MD  
Duane Norman, (301) 504-8092*

**Scientists no longer need to slaughter pigs to evaluate the animal's production of lean meat versus fat.** ARS researchers have adapted medical technology that gives accurate information on body composition while the hogs are still alive. Magnetic resonance imaging (MRI) shows "slices" of a pig's body, recording data on the animal's fat distribution, total body fat and muscle. Another system, Dual-Energy X-ray Absorptiometry (DEXA), provides a whole body scan of a live pig. Scientists now chart changes in a pig's body composition as it grows. These technologies could become especially useful in selecting breeding animals that produce the most lean meat.

*Growth Biology Laboratory, Beltsville, MD  
Al D. Mitchell, (301) 504-7124*

**Corn residues from distilling ethanol can be used to feed tilapia fish at a fraction of the cost of current fishmeal—and the fish taste just as good.** Corn-based feed costs about 18 to 23 percent less than commercial fishmeal. In ARS tests, tilapia gained about a pound of weight for every two pounds of feed when they ate either corn gluten meal, corn distillers' grain with solubles or corn gluten feed, plus soybean meal for extra protein. Researchers' next goal: refining the ration so weight gained per pound of feed is equivalent to that achieved from fish meal rations. Tilapia sales are among the fastest-growing in U.S. aquaculture. Consumers in 1994 bought about 66.5 million pounds live weight of tilapia, of which 50 million pounds were imported.

*Biopolymer Research, Peoria, IL  
David J. Sessa, (309) 681-6351*

**Refrigeration apparently lowers the viability of sperm used to artificially inseminate commercial turkey hens.** ARS tests found that sperm numbers on the turkey egg yolk membrane—a good gauge of egg fertility—are about 80 percent higher with fresh sperm versus refrigerated sperm. A turkey hen's body selects and stores sperm in reproductive tract tubules for fertilizing eggs throughout the 26-week egg-laying cycle. Typically only about one percent of fresh sperm make it to the tubules. When sperm's been refrigerated 24 hours, the number drops even lower. To compensate for drawbacks of stored sperm, growers double up on insemination doses or inseminate more frequently.



Virtually all commercially grown turkeys are produced by artificial insemination, and increasing storage time for semen would be beneficial to the industry.

*Germplasm and Gamete Physiology Laboratory,  
Beltsville, MD*

*Ann M. Donoghue, (301) 504-8580*

**A longer grazing season can be gained by ranchers who graze their animals on switchgrass pastures.** ARS and Iowa State University scientists added cool-season, nitrogen-fixing plants to pastures already planted with warm-season switchgrass. After a year, the legume plants provided enough nitrogen to increase growth of switchgrass. In northcentral states, the best switchgrass forage yields come in June through August, while the legumes produce their highest yields in cooler months. By growing legumes such as alfalfa, sweetclover, red clover and birdsfoot trefoil with switchgrass, livestock producers can ensure a good forage supply through a greater part of the year.

*Field Crops Research, Ames, IA*

*Dwayne R. Buxton, (515) 294-9654*

**Rhizoma peanut is a popular forage for cow-calf producers on the Gulf Coast.** A new study shows an additional use: Cattle may gain enough weight grazing rhizoma peanut to go directly from pasture to slaughter without the usual feedlot stint. Fat color and off-flavor problems often associated with forage-finishing apparently don't occur when steers eat rhizoma peanut. But the new study shows these animals' meat may be darker-colored and less tender, for a slight overall reduction in quality compared with steers fattened on grain-based feed. Producers planning to use rhizoma peanut to finish cattle may want to choose a cattle breed with greater genetic potential for tender meat.

*Subtropical Agricultural Research Station,  
Brooksville, FL*

*Andrew C. Hammond, (904) 796-3385*

## Animal Diseases and Pests

**Fire ants have gained a foothold in Tennessee, proving they can survive sub-freezing temperatures.** Scientists previously believed the ants could only overwinter in climates similar to their native South America. They are now established on 275 million acres in 11 southern states and Puerto Rico. But in 1992, USDA researchers discovered an isolated, 3,000-acre infestation of the pesky ants about 45 miles northeast of Chattanooga. The ants were thought to have been accidentally brought to the state in wood material from a pulp processing factory. In preliminary studies over the last few years, scientists found that eight percent of the

Tennessee colony survived the record-breaking cold temperatures of early 1994. One possible explanation: Two species have formed a hybrid ant that may be able to withstand northern winters. Once studies are complete, scientists hope to know more about the ultimate northern range of the fire ant, known for its aggressive behavior and painful stings.

*Medical and Veterinary Entomology Research Lab,  
Gainesville, FL*

*David F. Williams, (904) 374-5982*

**Just one *Toxoplasma gondii* parasite is all it takes to infect a pig.** Humans can get *T. gondii* infection by eating uncooked meat from infected animals or by swallowing food and water contaminated with infected cat feces that contains oocysts, a particularly hardy form of the parasite. Cats can excrete millions of oocysts after eating tissue of *T. gondii*-infected animals. It's not known how much *T. gondii* transmission to humans occurs through consumption of infected meat and how much results from direct contact with cat feces. If a woman becomes infected with *T. gondii* while pregnant, her child may be born mentally retarded or blind. Researchers say pork producers should keep cats away from swine feed supplies.

*Parasite Biology and Epidemiology Laboratory,  
Beltsville, MD*

*J.P. Dubey, (301) 504-8128*

**Treating broiler chicks with a blend of bacteria reduced the chicks' salmonella count to only about one-third of one percent of those in untreated chicks.** That count was taken in the chicks' intestinal pouches called ceca. ARS scientists made the treatment, called CF3, from intestinal bacteria in mature chickens, which are naturally more resistant to microorganisms such as salmonella. In tests, the scientists dosed 100 broiler chicks at one day of age with CF3, but didn't give the treatment to a second group of 100 chicks. Two days later, all the chicks were given 10,000 *Salmonella typhimurium* bacteria apiece. When the birds' intestines were checked at four weeks of age, the CF3-treated chicks had less than 10 *Salmonella typhimurium* bacteria per gram of cecal content, compared with about 3,000 per gram in the untreated birds.

*Food Animal Protection Research Laboratory,  
College Station, TX*

*Michael E. Hume, (409) 260-9404*

**A protein from cattle grub larvae is the foundation of a promising new environmental-friendly vaccine against grubs.** These grubs—the larvae of heel flies—damage meat and hides by cutting holes in the animal's skin. Limited availability of larvae had thwarted development of a cost-effective, protein-based vaccine.

But ARS researchers and researchers from Berlex Biosciences in Richmond, CA, cloned the grub protein, inserted it into a bacterium and now can grow large quantities of the protein inexpensively. Calves vaccinated with the protein had 50 percent fewer mature grubs than did unprotected calves. Each year grubs cost the cattle industry millions of dollars in damaged meat, hides and chemical controls. A safe, effective vaccine also can help eliminate the use of chemicals that are toxic to the environment. In the spring of 1996, the Canada-Alberta Livestock Research Trust, Inc., will be testing a recombinant vaccine in Canada and Europe.

*Livestock Insects Research Laboratory, Kerrville, TX  
John H. Pruett, (210) 792-0322*

**Stripping away the genetic "overcoat" that keeps nose-um biting midges warm in winter will reduce the spread of bluetongue, a livestock virus.** That's what ARS scientists would like to see happen, now that they have found a potential genetic key to altering its cold-weather defense. These midges—officially known as *Culicoides variipennis sonorensis*—spread bluetongue among domestic sheep and cattle. Bluetongue causes approximately \$120 million in losses annually to domestic livestock producers, mainly in export markets lost in countries that do not have the disease. Now, ARS scientists have discovered that the midge produces at least seven proteins to protect itself from freezing temperatures. By learning more about the survival mechanism, scientists may be able to use genetic manipulation to remove this advantage. That would reduce the insect's winter survival chances and its ability to spread the disease to healthy animals when spring arrives.

*Arthropod-borne Animal Diseases Research  
Laboratory, Laramie, WY  
Richard A. Nunamaker, (307) 766-3624*

## Genetic Resources

**A genetic switch that makes certain fungi start producing aflatoxin has been isolated for the first time.** This discovery could lead to improved resistance to the fungi in vulnerable crops—corn, cotton and peanuts. ARS scientists located clusters of genes in the fungi *Aspergillus flavus* and *A. paraciticus* for fungi growth and aflatoxin production. They then found a way to disrupt the "master switch" gene and shut it down, proving they had found aflatoxin's genetic coding. For now, researchers are using the genetic code to search out existing corn varieties that resist the fungi. A test has been developed that tracks the activity of the aflatoxin master switch gene throughout a corn seed

sample using live *A. flavus* fungi. Where activity is high, a bright blue stain appears. Corn seed with less stain shows a high potential for fungal resistance.

*Commodity Safety Research, New Orleans, LA  
Thomas E. Cleveland, (504) 286-4387*

**A genetically engineered tomato plant from ARS has a new natural shield against cucumber mosaic virus.**

Worldwide, this viral disease can inflict severe losses in tomato, cucumber, spinach and other vegetables. Insecticides to kill aphids that carry the virus don't always control its spread. Genes from a molecular enemy of the virus, transferred to experimental plants, worked well as a defense in the first ARS field test last year. A second test is underway. The virus rival, a molecule called S-CARNA 5, is a string of gene material called ribonucleic acid, or RNA. S-CARNA 5 subverts for its own purpose the virus' ability to multiply. Thus, the virus can't cause symptoms. ARS scientists inserted the RNA into a commercial tomato called UC28B. In virus-infected plots, the plants yielded 50 percent more tomatoes than plants without S-CARNA 5 genes. S-CARNA 5 is harmless to humans, animals and insects. Additional studies will further assess effectiveness and environmental safety of the gene defense.

*Molecular Plant Pathology Laboratory, Beltsville, MD  
Jacobus Kaper/Marie Tousignant, (301) 504-5745*

**A primitive fungus is the crucial carrier in a patented new biotech process for moving desirable genes into plants.** Use of the fungus makes possible genetic transfers to a wide variety of plants. The soil-dwelling fungus, *Olpidium zoospore*, is found in temperate climates worldwide. ARS scientists are using it to help transfer traits for qualities such as enhanced plant growth, improved seed and better disease resistance. DNA-transfer methods usually rely on bacterial vectors, but these are mostly limited to plants in the potato family, including potatoes, tobacco and tomatoes. *Olpidium's* broader range of hosts, from grasses to broadleaf plants, makes possible genetic transfers to more types of plants. (PATENT 5,416,010)

*Wheat, Sorghum and Forage Research, Lincoln, NE  
William Langenberg/Lingyu Zhang, (402) 472-3162*

## Crop Productivity

**Two new soybean varieties will give southeastern farmers bigger yields and higher-protein meal.** Developed for southern climates by ARS scientists, the new soybeans—N86-7682 and N87-984—are set for release in 1996. In field tests, N86-7682 outproduced other widely used, southern, commercial varieties such as Clifford and



Hutcheson by as much as seven bushels per acre. Clifford and Hutcheson average 48 bushels per acre. This new soybean can be used for feed or as a consumer crop. N87-984 could give poultry farmers a 52 percent-protein feed meal, compared with the current industry standard of 48 percent.

*Soybean and Nitrogen Fixation Research,  
Raleigh, NC*

*Richard F. Wilson, (919) 515-3171*

**A new breeding line developed from a wild Chinese soybean could lead to new varieties that stay dry even when harvest is delayed by rainy weather.** That's good news for southern producers whose soybean harvesting is often hindered by hurricanes and wet weather. A two-week delay in harvesting can cost soybean growers about \$270 an acre. Developed by an ARS plant breeder, soybeans developed from D86-4565 don't require drying air to be forced through storage bins. In plantings in Louisiana, D86-4565 yielded 45 bushels per acre, about the same as "Forrest," a commercial variety. After two weeks of rainy weather, the new line was of good quality, while seed of "Forrest" was unmarketable.

*Soybean Production Research, Stoneville, MS  
Edgar E. Hartwig, (601) 686-3216*

**A new grape from ARS yields sweet, juicy raisins that dry on the vine.** DOVine (the "DOV" is for "dry on vine") raisins taste better than regular ones dried in vineyard trays. When DOVine's fruit-bearing canes are cut, the grapes dry on trellises, forming raisins that can be mechanically harvested. This year, after five years of experimental plantings, ARS offered DOVine cuttings to growers and nurseries. Other varieties can be vine-dried, but DOVine is ready to harvest sooner. So, the raisins are less likely to be damaged by early rains. DOVine is probably the world's only commercial seedless grape produced from two seedless parents. Typically, breeders use one seeded and one seedless parent, a slower approach because only 15 to 30 percent of the new vines will produce seedless grapes. Embryo rescue—the biotech maneuver—is about two to three times as efficient, with about 50 to 85 percent of the new vines yielding seedless grapes. Scientists used pollen from one seedless parent to fertilize the flowers of another seedless vine. The new grapes, produced from the fertilized flowers, each contain an embryo or seed wisp so small that it normally wouldn't survive. Scientists removed the wisps from the developing grapes, then nurtured them on special nutrients until they formed plants large enough to be moved from the laboratory to the greenhouse and then to the research vineyard.

*Horticultural Crops Research Laboratory,  
Fresno, CA*

*David W. Ramming, (209) 453-3000*

**Vavilov and Douglas, two new crested wheatgrasses from ARS, should help fight erosion as well as feed wildlife and cattle on western ranges.** Both grasses are drought tolerant and produce strong roots that help hold soil in place. In some regions of the Great Plains and Intermountain West, they can supply spring and autumn forage at altitudes up to 7,500 feet. ARS scientists began breeding and field-testing the grasses more than 10 years ago. They can now provide breeders with small quantities of seed of the new varieties. Utah Crop Improvement Association keeps stocks for commercial seed producers. Vavilov crested wheatgrass can survive with only eight inches of water a year; Douglas needs at least 10. Vavilov is named after Soviet plant geneticist Nikolay Vavilov, who died in a Stalinist camp in 1943. He established one of the world's foremost collections of plant seeds. Douglas is named for the late Douglas Dewey, an ARS researcher who became a world authority on wheatgrasses and related species. He developed more than 200 new grass hybrids that scientists can use in developing improved grasses.

*Forage and Range Research Unit, Logan, UT  
N. Jerry Chatterton, (801) 797-2249*

**Tilling farm fields at night may be a nightmare for weeds.** ARS research in corn fields showed nighttime tillage can cut some weed problems in half. Unlike daylight tillage where light penetrates the soil to break the dormancy of buried weed seeds, tilling at night prevents this from occurring. Night tillage postpones some weed emergence, causing seeds to become less viable and more prone to attack by soil microbes. Small seeded broadleaf weeds were the hardest hit—less than 50 percent emerged. Some large seeded weeds, like velvetleaf, cocklebur and annual grass species still sprouted after night tilling. Still, the overall result was fewer weeds—meaning reduced tractor trips and herbicides. This adds up to savings for farmers while sustaining the environment.

*National Soil Tilth Laboratory, Ames, IA  
Douglas Buhler, (515) 294-5502*

**Fungi living in desert soils may be a major reason why desert plants can survive on scant water and in scorching heat.** ARS scientists discovered three types of fungi thriving on the roots of desert plants. These fungi help roots take up essential plant nutrients. On the other hand, they may protect roots from taking in excessive or toxic amounts of minerals and salts. Scientists identified the fungi while collecting several desert fungi in New Mexico and surrounding states. They believe the microbes may have been there for thousands of years, but no one thought they were important to study until recently. Also uncovered were bacterial colonies that grow with the fungi on sand particles. It seems the

bacteria have the ability to dissolve the sand, releasing minerals for plant use and generating new soil. Greater understanding of underground plant-soil-microbe relationships helps the scientists develop recommendations for improving the capacity of desert range to support wild and domestic grazing animals.

*Rangeland Management Research, Las Cruces, NM  
Jerry R. Barrow, (505) 646-4842*

**A new potting mix for plants gets its nutrients from solids screened from the wastewater of trout tanks.** Fish manure, uneaten fish food and other solids supply nutrients needed to enrich the soil. ARS scientists also added straw, another waste product, in developing the potting mix. It was tested as a replacement for rockwool, a commercial growth medium that has a high water-holding capacity and good aeration properties. Test results: lettuce was comparable in quality and yield to that grown in the commercial medium. The next step will be to add disease-suppressing microorganisms to the potting mix.

*Appalachian Fruit Research Laboratory,  
Kearneysville, WV  
D. Michael Glenn, (304) 725-3451*

**A new gel mixture made primarily from cornstarch is proving successful in supplying nutrients so tiny apple, pear and raspberry plants thrive in laboratory jars.** This technique, called tissue culture, makes it possible to grow hundreds of plants compared to a handful started from rootstock. ARS scientists found the gel produced healthier plants at only a fraction of the cost of agar now imported for tissue culture use. Agar costs about \$98 per pound, while a pound of cornstarch sells for about 89 cents—less if purchased in bulk. Spain is the world's largest supplier of agar, which is made from a type of algae that grows primarily off the coasts of Spain and Mexico. Agar for tissue culture is now used by about 100 companies in this country. Two companies are interested in commercializing the gel.

*Fruit Laboratory, Beltsville, MD  
Ingrid Fordham, (301) 504-7649*

## Crop Diseases and Pests

**A new wood-boring wasp species, discovered in coniferous forests in Chile, could threaten U.S. forests.** Wood-boring wasps already in this country cause millions of dollars of damage each year. They can reduce the quality of lumber and cause concern to building owners when adult insects emerge after wood is used in construction. ARS scientists identified the new

wasp, *Derecyrtia beechei*, n. sp., in the family *Xiphydriidae*. That identification is critical, because the species possess characteristics similar to two other known types of wood-boring wasps. Wood borers can be transported in commercial shipping, so preventing their introduction into the United States and other countries is important. If these pests are encountered at ports of entry, specific identification could save action agencies like USDA's Animal and Plant Health Inspection Service time and money in detecting them and disposing of infested materials.

*Systematic Entomology Laboratory, Washington, DC  
David R. Smith, (202) 382-1783*

**Three new "half-runner" snap beans have been developed to resist the rust fungus, *Uromyces appendiculatus*.** That should please gardeners and commercial growers, especially in the Appalachian region of Tennessee, North Carolina and West Virginia. Half-runners—whose vines run along the ground—are popular in the region. But available half-runner varieties are extremely vulnerable to attack by the fungus. Under cool, moist conditions, it can erase 50 to 80 percent of the potential yield. To combat the fungus, ARS and University of Tennessee scientists released the seed of three new bean germplasm lines to plant breeders. BelTenn Rust-Resistant 1, 2 and 3 ward off all 66 known races of *U. appendiculatus*. BelTenn vines grow one to two feet long and produce tasty, large, white beans with edible pods. To develop the new lines, scientists made several crosses of a rust-resistant Guatemalan bean, several experimental lines and a commercial variety, Mountaineer White Half-Runner. They then verified the resistance trait in progeny from each cross.

*Molecular Plant Pathology Laboratory,  
Beltsville, MD  
J. Rennie Stavely, (301) 504-6600*

**An altered strain of bacteria may defend snap beans against brown spot disease.** An ARS researcher developed a non-disease-causing strain of *Pseudomonas* pv *syringae*, the bacteria that normally causes brown spots in beans. In field studies conducted with University of Wisconsin scientists in 1991 and 1993, the altered bacteria sprayed on beans suppressed numbers of its disease-causing parent by as much as 98 percent. In a wet season growers in Wisconsin may lose about \$1 million in unmarketable beans because of brown spots. If this bacterium can be developed into a product to control brown spot, these growers might benefit. Other states that produce sizeable green bean harvests include Illinois, Michigan and Oregon.

*Plant Disease Resistance, Madison, WI  
Christen D. Upper/D. Kyle Willis, (608) 263-2092*



One cherry grower in northern California who followed recommendations for controlling buckskin disease confined infection to an average three percent in his orchard during a six-year period. Another who ignored his buckskin problem had more than 60 percent of his trees infected. The disease is often fatal to cherry trees, wiping out entire orchards in two or three years. But ARS researchers have proven to growers that buckskin can be kept in check by following a series of guidelines that thwart its spread. Recommendations include prompt removal of infected trees and tree stumps, monitoring for leafhoppers that carry disease microorganisms, and careful insecticide applications. Scientists are now working on more sensitive tests to detect the disease-causing organism, a mycoplasma-like microorganism. The tests would more readily identify which plants are serving as disease reservoirs. Buckskin was first noted in California in 1931, then was quickly identified in eastern U.S. orchards and in Washington state.

*Crops Pathology and Genetics Research Unit,  
Davis, CA  
Jerry K. Uyemoto, (916) 752-0309*

**Hairy nightshade, a common weed in potato-growing areas of Washington and New York, is harboring fungicide-resistant strains of the fungus that causes potato late blight.** *Phytophthora infestans* unfortunately is now resistant to the most widely used chemicals. ARS scientists say the weed appears to be an alternate host for this fungus during periods when there are no potatoes or tomatoes. Growers must use culling, good sanitation practices and other non-chemical measures to control late blight, the disease that caused the 1845 Irish potato famine. Up to 20 percent of the U.S. potato crop succumbed to potato late blight during the past three years, with losses of \$200 million in 1994.

*Vegetable Laboratory, Beltsville, MD  
Kenneth L. Deahl, (301) 504-5216*

## **Industrial (Non-Food) Products**

**Bacteria are helping convert citrus waste into ethanol, acetic acid and carbon dioxide—all industrial products that could be made using ARS technology.** Citrus processing creates more than 800,000 tons of dried citrus waste annually that must be disposed of in an environmentally acceptable way. Currently, it's processed into low-value animal feed. ARS researchers used enzymes to ferment the waste's simple sugars and developed a filter system to trap peel oil. They used

yeast to convert the sugars to ethanol and *E. coli* bacterium to break down the more complex sugars from the oil. Ethanol is a biofuel and acetic acid can be used in many food and industrial products such as vinegar, flavor components and organic solvents. Carbon dioxide can be recaptured to make dry ice. The conversion process takes only 48 hours. Scientists from the University of Florida collaborated on the research.

*Citrus and Subtropical Products Laboratory, Winter Haven, FL  
Karel Grohmann, (813) 293-4133*

**A leftover from sugarcane processing—called bagasse—can be chemically modified into an environmentally friendly "cleaner" to remove cotton dyes from textile mill wastewater.** ARS tests found the finely milled, chemically treated bagasse, called quarternized resin, readily bound about 28 times as much Remazol Brilliant Red reactive dye as did regular bagasse. Scientists estimate the recyclable bagasse-based resin would clean wastewater for less than half the cost of activated sludge or chemical bleaching methods now used by the textile industry.

*Food Physical Chemistry Research, Peoria, IL  
Joseph A. Laszlo, (309) 681-6322*

**ARS researchers have found a way to prevent a modified cotton product known as Cellulose III from reverting to regular cotton, or Cellulose I, when exposed to moisture.** Cellulose III is used in cotton clothing. Originally, British scientists found that treating cotton with liquid ammonia caused subtle changes in the crystal structures of cotton fiber and yarn. Special processing conditions resulted in a much stronger sewing thread than was possible with conventional caustic treatments. Yarn treated in a similar way was found to produce a smooth fabric with improved wash-and-wear ratings. But the new fiber would return to Cellulose I when it got wet, causing some decrease in the improved properties. Several scientists have experimented with temperature, pressure and other methods to develop a stable Cellulose III product. ARS tests showed that using ammonia vapors and high pressure (100-1700 pounds per square inch) would result in complete and irreversible conversion to Cellulose III. Regular cotton was immersed in ammonia and subjected to high pressure in a device called a Parr bomb. Resulting Cellulose III was stable in boiling water. (PATENT 5,322,524)

*Southern Regional Research Center, New Orleans, LA  
Timothy Calamari, (504) 286-4265*

## Soil, Water and Air Quality

Much of the organic matter being lost from America's croplands may literally be going up in a puff of gas—as carbon dioxide. An ARS study found that loss rates are fastest within minutes after plows break the surface, letting oxygen into soil. Carbon is the backbone of the organic matter that makes the black soils of the Corn Belt as fertile as they are. The extra oxygen permeating the soil stimulates microbes to chew faster on the organic matter. As a result, more carbon dioxide seeps into the soil's air spaces and escapes during plowing, contributing to a potential global warming. The study recorded carbon released from wheat fields plowed in the fall. After 19 days, total losses of carbon were up to five times higher than for unplowed fields. As much carbon escaped into the air in the form of carbon dioxide as was added to the soil the previous season by wheat crop residue left on the field. Losses can vary two- to three-fold in a distance of 50 feet. These findings point to the value of not plowing fields. But, when plowing is required, ARS scientists are trying to put a dollar value on the losses to see if it's worth developing sensors so tillage machines can disturb the soil less on parts of fields most likely to lose carbon dioxide.

*North Central Soil Conservation Research  
Laboratory, Morris, MN  
Donald C. Reicosky, (612) 589-3411*

**How much can a change in the use of farm acreage reduce soil erosion in a watershed?** A drop in cultivated acreage—from 1211 to 579 acres—decreased soil erosion from agriculture by 42 percent on the 8.2-square-mile Goodwin Creek Experimental Watershed in the hills region of north central Mississippi. That was the finding of ARS researchers who compiled a wealth of data on rainfall, soil type, stream sediment, bank stability and land use over 10 years. As a result, a study yielded a picture for the first time of how changes in land use—such as shifting erosion-prone, cultivated land to pasture and forest—can protect soil resources. On a yearly basis, the concentration of fine particles in runoff water decreased from 2600 to 1200 parts per million.

*National Sedimentation Laboratory, Oxford, MS  
Roger Kuhnle, (601) 232-2971*

**As herbicide is sprayed on a field, some of the herbicide's particles drift into the air.** ARS researchers sampled rainwater over four years to find how much of an airborne herbicide like atrazine will "wash out" in rainstorms that unexpectedly occur after herbicide is sprayed on farm fields. An analysis found herbicides in the rainfall are at levels safe for drinking water—less than one microgram per liter. That compares to the

federal minimum of three microgram per liter for atrazine. All the water sampling was done at two sites in the Walnut Creek watershed of central Iowa after each rainstorm. Herbicides—including atrazine and metolachlor—appeared primarily in samples during the spring, when they were being applied. Nitrate from nitrogen fertilizer was detected in samples throughout the year. Except for one sample, nitrate levels in rainwater averaged 1.5 parts per million throughout the year. Over a year, nitrate deposits totalled over 11 pounds per acre. Such research on herbicides and nitrate deposited in rainfall will help develop efficient application methods for farmers to protect rainwater.

*National Soil Tilth Laboratory, Ames, IA  
Jerry Hatfield, (515) 294-5723*

**Chemicals leave behind molecular "fingerprints" in resins that help pinpoint contaminants in soil, water or food.** ARS researchers worked out the resin imprints to get a first-step identification of herbicides in about 10 minutes. That would make it possible to quickly separate extraneous chemicals and zero in on the specific chemical in further analytical procedures. In tests, researchers mixed triazine herbicides with compounds that hardened into tough resin. When the resin was ground into particles, imprints of the herbicides' molecular structure stayed on the particles' surface. If a water sample containing triazine herbicides is mixed with the particles, the chemical molecules in the water fit into the imprints like pieces of a puzzle.

*Food Animal Protection Research Laboratory,  
College Station, TX  
Larry H. Stanker, (409) 260-9306*

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# Quarterly Report

of Selected Research Projects

October 1 to December 31, 1995

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## Into the Marketplace

### Cooperative Research and Development Agreements

...With Union Camp Corp. of Wayne, NJ, to develop ways to use an ARS product as a low-cost, environmentally friendly ingredient in adhesives, insulation, plywood, particle board and box board. The ARS product, Fantesk, is a mixture that can be made from a variety of starches and vegetable oils. Fantesk can be formed into adhesives that may partially replace more expensive and less environmentally friendly materials such as urea-formaldehyde and phenol-formaldehydes used in manufacturing particle board and plywood. Researchers will also explore potential use of Fantesk in water-based paints and coatings for paper, box board and plant seedlings.

Contact the scientists who are listed for further information on each research project. For general questions about this report, contact Sean Adams or Lisa Spurlock, ARS Information, 6303 Ivy Lane, 4th Floor, Greenbelt, MD 20770, (301) 344-2723/2824, sadams@asrr.arsusda.gov or lspurloc@asrr.arsusda.gov

Items marked with the word PATENT are being patented by ARS. For more information on patents, CRADAs and patent licenses, contact C. Andrew Watkins, National Patent Program, Bldg. 005, Rm. 416, BARC-West, Beltsville, MD 20705, (301) 504-5734. Questions about a company's product and/or research should be directed to the company itself.

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ARS Contact: Kenneth Eskins, National Center for Agricultural Utilization Research, Peoria, IL, (309) 681-6566

...With PhotoDye International, Inc., Linthicum, MD, to develop precise formulations for a bait to mix with dye that kills Mediterranean and Mexican fruit flies and related pests. PhotoDye holds rights to use some dyes as sun-activated, environmentally friendly insecticides. ARS scientists have demonstrated that a red dye kills Mediterranean and Mexican fruit flies soon after they eat it and are exposed to sunlight. The dye, used in some popular stomach antacids, is rated safe for humans by the Food and Drug Administration. Under two CRADAs, ARS researchers will pinpoint the best combination of bait, dye concentration and other ingredients to attract each fly species and stimulate them to feed on the dye. The Medfly attacks more than 300 different fruits and vegetables and is among the world's worst agricultural pests. Crops in California, Arizona, Texas, and Florida are particularly vulnerable to medflies that hitchhike to the U.S. mainland in smuggled produce. The Mexican fruit fly chronically threatens citrus orchards in Texas and occasionally invades California orchards as well.

ARS contacts: Nicanor J. Liquido, Tropical Fruit and Vegetable Research Lab, Hilo, HI, (808) 959-4334; Robert L. Mangan, Subtropical Agricultural Research Lab, Weslaco, TX, (210) 565-2647

...With Alpha Food Ingredients of Evanston, IL, to evaluate new edible coatings for fruit products made from pureed fruit. ARS scientists are developing a process that combines pureed apricots, pears and peaches with various gelling agents, such as starch, to form tasty fruit pieces. The coating will help the fruit pieces stay moist and last longer. The goal is to increase consumers' fruit consumption by using restructured fruit pieces as ingredients in ice cream, baked goods or other products, or as alternatives to candy. By pureeing perishable fruit at harvest time, fruit pieces can be produced throughout the year. Alpha Foods licensed technology from Argonne National Laboratories to apply the novel high-molecular-weight polylactic acid coating to foods. ARS scientists are determining the barrier properties of these novel coatings and investigating the effects of the coatings on the color, texture and shelf-life of the fruit products.

ARS Contact: Tara McHugh, Western Regional Research Center, Albany, CA, (510) 559-5864



...With Natural Fibers Corp., Ogallala, NE, to create a filler material for comforters using a non-woven blend of wool or cotton and milkweed floss. The company has used a floss and down blend as filling, but would like to expand its consumer base by offering both the down blend and a more inexpensive product. A problem: The milkweed floss is delicate and breaks down during mechanical production. Down-blend material is merely blown into the comforter's outer shell so fiber breakage is not an issue. ARS researchers found that using cotton or wool strengthens the floss and makes it possible to produce the non-woven product.

ARS Contact: Weiying Tao, Textile Engineering Research, New Orleans, LA, (504) 286-4540

...With Patchen California, Inc. of Los Gatos, CA, to develop sensor-controlled herbicide sprayers to combat weeds that sprout between rows of crops such as soybeans, corn and cotton. ARS scientists treated soybean fields using sensor technology developed by Patchen for use in orchards and vineyards. The sprayer only releases chemicals when its sensors detect weeds. Field studies in 1995 showed the sprayer cut chemical use 50 to 85 percent while providing good weed control. In 1996, researchers will test the technology on cotton and re-evaluate its use on soybeans.

ARS Contact: James E. Hanks, Application and Production Technology Research, Stoneville, MS, (601) 686-5382

...With Strauch and Sons, Inc., of Bethesda, MD, to test a device that sprays low levels of insecticides under plant leaves where damaging whiteflies feed. Insecticide applicators generally don't reach under leaves—one reason that the sweetpotato whitefly (B strain), *Bemisia argentifolii*, has spread and damaged vegetable crops across the United States. Strauch's new sprayer disperses a fine mist that reaches under leaves to kill feeding whiteflies. ARS will initially test the fogger in greenhouse studies using insecticides and new, ARS-developed natural products, called sugar esters, against whiteflies. These sugar esters, derived from tobacco leaves, break down the insect's outer shell, causing the pest to shrivel as it loses water. If the greenhouse tests are successful, field studies will begin later this year.

ARS Contact: Alvin M. Simmons, U.S. Vegetable Lab, Charleston, SC, (803) 556-0840

...With DNA Plant Technology Corporation (DNAP) of Oakland, CA, to field test tomatoes grown from tissue culture. ARS scientists developed technology that can enhance sweetness, increase meatiness and extend the shelf life of fresh-market tomatoes. DNAP researchers will evaluate the consumer appeal, genetic stability and storage characteristics of the tomatoes. DNAP will also cross ARS lines with their own varieties to further improve commercial potential. These hybrids should

greatly reduce production costs, maintain quality during handling and shipping and extend the fruit's shelf life.

ARS Contact: George Robertson, Western Regional Research Center, Albany, CA, (510) 559-5866

...With ICI Seeds, of Slater, IA, to determine how quickly European corn borers may become resistant to a *Bacillus thuringiensis* (Bt) toxin in transgenic corn. Scientists are concerned that borers surviving the Bt-bearing corn could become the forefathers of tomorrow's resistant insects. In the laboratory, researchers will monitor insects for Bt-toxin resistance for at least six generations and try to develop resistance management strategies.

ARS Contact: Leslie C. Lewis, Corn Insects Research, Ames, IA, (515) 294-8614

## Industrial (Non-Food) Products

Harvesting and selling pine needles could provide extra income for the small rural landowner with pine tree plantings. The needles—called "pine straw"—are a sought-after commodity among landscapers who use them for mulch. Also, building contractors spread them at building sites to reduce soil disturbance by equipment. In the Mid-South, pine straw yields can reach 150 bales per acre at 30 to 40 pounds per bale, selling for as much as \$8 per bale, beginning when the trees are about eight years old. The pine straw must be raked into piles, taking care to avoid sticks and other trash that can lower the value of the product. But it then can be baled with the same machinery used to bale hay. Straw can be harvested anytime during the trees' shedding season from August to January, but maximum yields typically come in October and November. In field tests in Arkansas from 1990-1995, pine straw yields from 16-year-old loblolly pines averaged 480 pounds per acre in August, slightly more in September and October, and a maximum of 1,603 pounds per acre in November. Another income option for pine-planting owners: leasing the land for pine straw harvesting.

South Central Family Farm Research Center, Booneville, AR  
Catalino A. Blanche, (501) 675-3834

A nutritionally essential fatty acid has been newly-identified in certain strains of fungi—opening the door to a new, fermentation, technology-based growth industry for the fatty acid. That acid—arachidonic acid—is found only in trace amounts in animal fats. But now the fungi could become a rich new source for the fatty acid products ranging from pharmaceuticals to agricultural chemicals that enhance plants' natural resistance to disease. Cooperating ARS and Russian scientists discovered arachidonic acid makes up more than 40 percent of lipids in at least three strains of *Mortierella*



fungi. These acid-rich fungi were among 87 strains examined from three microorganism collections, including the ARS Culture Collection in Peoria, IL.

*Fermentation Research, Peoria, IL  
Rodney J. Bothast, (309) 681-6566*

## Human Nutrition

**Pregnant women who develop diabetes don't burn the fat, or triglycerides, circulating in their blood as readily as women who have normal pregnancies.** So there's more fat available to the fetus, a study shows. This may explain why women who develop gestational diabetes mellitus (GDM) have large babies and thus more delivery complications, even when treated with insulin.

About two to three percent of pregnant women develop GDM. While it generally resolves after delivery, GDM raises the woman's risk of developing diabetes later in life. Insulin affects the body's metabolism of fats and amino acids—the building blocks of protein—as well as glucose. So researchers measured oxidation rates of these major nutrients in normal and GDM mothers in their last trimester and again six weeks after delivery. Although the GDM mothers were taking insulin, their fat oxidation was slower both before and after delivery. The findings strengthen evidence that diabetes is more than a disorder of glucose metabolism.

*Children's Nutrition Research Center, Houston, TX  
Nancy Butte, (701) 798-7000*

**A study of five healthy males eating meals rich in selenium suggests extra selenium may help cancer or AIDS patients prevent unwanted weight loss.** The patients may even add a few pounds. ARS nutrition researchers stress the findings, while preliminary, point to the possibility of a previously unknown side benefit of selenium used in experimental treatments for cancer and AIDS. In the ARS study, the volunteers ate a selenium-rich diet that supplied five times the Recommended Dietary Allowance (RDA) of selenium—but only enough calories to maintain each man's starting weight. Still, they gained an average 1½ pounds over 14 weeks. A potential explanation, according to the scientists, may be that the selenium reduced levels of  $T_3$ , a thyroid hormone. Researchers already knew that  $T_3$  controls the body's calorie-burning rate and that the thyroid needs selenium to make  $T_3$ . But the ARS study may be the first to show that eating foods high in selenium lowers rates of calorie burning. ARS researchers plan to repeat the study to see if the same effect occurs and how long it persists. As an experimental practice in medicine, selenium treatments must be carefully monitored—over time, amounts 10 times the RDA can be toxic.

*Western Human Nutrition Research Center,  
San Francisco, CA*

*Wayne Chris Hawkes/Nancy L. Keim, (415) 556-1377*

**Oatrim—a fiber-rich fat replacer made from oats—may have a role in reducing the risk of heart disease.** An 11-week study found that Oatrim dramatically reduced oxidation of fatty acids in 24 men and women. Oxidation of fats circulating in the blood is believed to trigger the process that leads to blocked arteries. So a reduction in oxidation could lower the risk of heart disease. When the volunteers ate foods made with Oatrim at every meal, urinary levels of a common indicator of fat oxidation—malondialdehyde—dropped by 80 percent. This finding supports evidence that oat extracts contain substances that prevent damage to fatty acids in the body. And it suggests that substances other than the cholesterol-lowering beta glucans in oats are responsible. Volunteers had about the same drop in oxidation whether the Oatrim they consumed contained one percent or 10 percent beta glucans. As reported earlier, eating foods containing Oatrim significantly lowered blood cholesterol and systolic blood pressure and improved glucose tolerance, which reduces risk of diabetes. Also, Oatrim holds promise in weight reduction: Volunteers in the study lost weight despite every effort to keep weight constant. Developed by an ARS scientist, Oatrim is in a growing number of name brand foods, and the flour-like product can be purchased commercially. (PATENT 4,996,63)

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*Judith G. Hallfrisch, (301) 344-8396*

**Cutting calories throughout adult life increasingly appears to reduce the diseases of aging.** A study of pigs brings the evidence closer to home. The pigs were kept on a weight-maintenance diet well into old age and did not have the same deterioration in glucose and lipid metabolism that normally occurs in humans and laboratory animals as they age. Blood sugar, fat and cholesterol levels of the old animals—up to age 14—were in the same range as the young pigs. Also, levels of insulin and the many other hormones that control glucose and lipid metabolism were about the same as in the young pigs. When given the choice, pigs keep increasing their food intake as they grow older and put on fat. These pigs, however, were fed one-third to one-half fewer calories than they would liked to have eaten to keep them at their young adult weight. In people, that would be akin to maintaining ideal weight. For more than 50 years, researchers have seen much longer life spans in rodents who were maintained on 50 to 65 percent of their preferred calorie intake. And current studies with monkeys, which are closer in their physiology and biochemistry to humans, are showing a slowing of the aging process. Now pigs—also a good model for humans—further support the evidence. Before any recommendations can be made for people, however, more research is needed to define what ideal weight



really is and to develop austere diets that provide all the essential nutrients. The study was done in collaboration with the Food and Drug Administration.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Sam Bhathena, (301) 504-8422*

**Protein malnutrition leaves the intestinal lining vulnerable to bacteria, toxins and food antigens.** That happens, researchers found, because cells in the lining lose much of their ability to make a first line of defense—glutathione in its chemically reduced form. This finding from a study of pigs helps explain why protein-malnourished children are so susceptible to intestinal infections and chronic diarrhea, which further decreases their absorption of nutrients. Glutathione is composed of three amino acids—the smallest units of protein. In its chemically reduced form, it serves as the body's premier antioxidant and protector against toxins and food chemicals. So researchers wanted to know how protein deficiency affects the levels of reduced glutathione and its rate of synthesis. The most dramatic effect was seen in intestinal cells, where reduced glutathione levels were 63 percent below those in the control group, and the rate of synthesis was off by the same percent. Red blood cells followed suit, although not as dramatically. Liver cells were unaffected. When the pigs were stressed to simulate infection, synthesis increased in the red blood cells but levels dropped, indicating that the cells couldn't keep up with the demand. Researchers suspect that cysteine, one of three amino acids in glutathione, is the limiting nutrient. Although people and animals can make cysteine, extra seems needed in times of stress.

*Children's Nutrition Research Center, Houston, TX  
Farook Jahoor, (713) 798-7084*

**Estrogen has a quieting effect on the blood's clotting cells,** a study finds, and that may be one reason premenopausal women and older women who take estrogen have a lower risk of heart disease. In the study with 16 men and 24 women ranging in age from 38 to 61, blood platelets taken from the women on estrogen replacement therapy were calmer, or less activated, than those from the women who were not taking estrogen after menopause. Platelets orchestrate blood clotting by enlarging and sending out projections that interlock like Velcro with other platelets to plug a breach in a blood vessel. When activated unnecessarily, these platelet clumps contribute to the debris in arterial plaques and cause a heart attack or stroke when they completely clog an already narrowed artery. But platelets from the seven older women on estrogen-replacement therapy were as subdued as those from the younger women, while those from the men and older women not taking estrogen were more activated. Researchers conducted the study to determine the effects of moderate alcohol consumption

and high- or low-fat diets on risk factors for heart disease. Neither fat nor alcohol intake had any effect on platelet activation.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Norberta W. Schoene, (301) 504-8388*

**An estrogen-like compound in soybeans may help prevent heart attacks or strokes** by keeping the clot-forming cells in a quiet state. That's the implication from a study done on rats' blood. When researchers add a clot-inducing chemical to the blood, the platelets become activated and clump together. By treating the blood with the plant estrogen, genistein, before adding the clot inducer, the researchers reduced platelet aggregation by 57 percent. This suggests that genistein and other phytoestrogens could prevent unnecessary clots. These clots contribute to plaque formation and then clog an already narrowed artery to cause a heart attack or stroke. Until now, the only evidence that it may prevent heart attack or stroke is from studies of long-lived populations, such as the Japanese, who eat a lot of soy foods in a low-fat diet. Genistein is found in soy protein products, such as tofu, miso and vegetarian burgers or hot dogs. Results of this study should prompt more research on the benefits of natural plant estrogens.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD  
Norberta W. Schoene, (301) 504-8388*

**Small doses of the antioxidants beta carotene, vitamin E and selenium improved the immune response** of males in a large study in China. But combinations of other vitamins and minerals either had no effect on or inhibited the ability of T cells to multiply when challenged—a test commonly used to determine how well the immune system is functioning. Among their many functions, T cells recognize cancer cells in the body and coordinate their destruction. ARS scientists tested T-cell proliferation for 400 of some 30,000 Chinese supplemented with various vitamin and mineral combinations over a five year period. They live in the Linxian region of China, where the population has one of the highest rates of cancer of the esophagus worldwide. Chinese health officials wanted to see if specific nutrients could lower risk in people who had no signs of this cancer. Whenever the combination containing only 15 milligrams (mg) of beta carotene, 30 mg of vitamin E and 50 micrograms (mcg) of selenium was given, T-cell proliferation improved significantly in the males but not in the females. On the other hand, conservative doses of vitamin A and zinc had no effect and neither did two B vitamins—riboflavin and niacin. What's more, 120 mg of vitamin C and 30 mcg of molybdenum significantly depressed T-cell proliferation, again only in the males. Researchers don't have an explanation for this adverse effect but speculate that the two nutrients may have



interfered with the body's use of copper—known to be important to the immune system. In a concurrent study, nearly 3,500 people diagnosed with early signs of cancer of the esophagus got a multivitamin, multimineral supplement or a placebo daily for more than five years. ARS researchers ran T cell tests on 400 of these subjects also and found no difference in immune response between the two groups. In both studies, the supplements did not produce a statistically significant reduction of cancer incidence and mortality. But there was a downward trend among those who got the beta carotene-vitamin E-selenium combination.

*Beltsville Human Nutrition Research Center,  
Beltsville, MD*

*Tim R. Kramer, (301) 504-8459*

### **Food Safety and Quality**

Waiting for a hamburger to turn from pink to brown is not the best way to ensure thorough cooking. In a year-long ARS investigation, results repeatedly showed that meat may be well cooked even though it is still pink. On the other hand, researchers at Kansas State University, in a different study, found that meat could turn brown before it reached 160 degrees F, when burgers are considered fully cooked. ARS scientists analyzed 2,000 burgers—fresh and frozen—bought from meat suppliers. The different results between the two research groups may be due to KSU using thawed meat and ARS cooking frozen beef. The ARS experiments involved 17 burger formulas. When they fried fresh patties, more than 50 percent stayed pink when cooked to 160 degrees F. Of the burgers frozen for a year, all but one formula stayed pink after cooking. That one formula, however, turned brown at temperatures lower than 160 degrees.

*Meat Science Lab, Beltsville, MD*

*Brad Berry, (301) 504-8994*

Beef from vitamin E-fed cattle stays fresh longer and may require less preservatives in frozen meat products. Frozen ground beef in pizza toppings and other products can turn rancid from pre-cooking, salting and freezing. This means several chemical additives must be used to preserve the beef. Now, research shows that vitamin E beef may require less chemical preservatives in frozen meat products. The supplement seems to work because it is an antioxidant. When processed, the non-E beef turned rancid rapidly while the vitamin E-enhanced product held up slightly longer. Researchers caution the vitamin can extend beef shelf life but should not be relied on as the sole preservative. Ranchers and farmers have been using the supplement for about two years because it preserves meat color. But this research shows benefits extend beyond color quality to prevent off-flavor and rancidity.

*Meat Science Research Lab, Beltsville, MD  
Brad Berry, (301) 504-8994*

**Tasty, low-fat ice cream and a variety of other foods and non-food products may be developed from Fantesk, a new blend of starch, water and microdroplets of animal or vegetable fats. The combination can be formulated into gels, crystal flakes, powder or liquid, depending on how it is handled and blended into other materials. ARS scientists cooked the starches, oils and water into a thick gel that doesn't separate even when the gel is frozen, thawed and melted in a microwave oven. Fantesk could find a place in goods as diverse as industrial lubricants, hand lotions, pharmaceuticals and flavored coating for diet popcorn. (PATENT APPLICATION 08/233,173)**

*National Center for Agricultural Utilization  
Research, Peoria, IL*

*Kenneth Eskins/George Fanta, (309) 681-6566/6356*

### **Computer Systems and Models**

Farmers will get more accurate fertilizer recommendations and cut nitrogen fertilizer costs by \$10 to \$30 per acre by using a new computer program developed by ARS for soil testing laboratories. More accurate rates help reduce the environmental threat of excess nitrogen seeping into water supplies. ARS scientists used computers to predict more accurately how temperature influences the speed at which soil-borne microorganisms break down crop residue to release nitrogen. The new method cuts in half the error between measured and predicted amounts of nitrogen release from straw and stalks. Farmers in the East and Midwest will benefit most. That's because these soils contain more native organic matter than soils in drier areas in the West.

*Central Great Plains Research Station, Akron, CO  
Merle F. Vigil, (970) 345-2259*

There are bugs on the Internet. Information on more than 100,000 North American insects specimens will be available on the Internet. Developed by ARS scientists, the expert system is called Biosystematic Information on Terrestrial Arthropods (BIOTA). When completed in late 1996, BIOTA will give users electronic access to the combined knowledge of 22 ARS scientists and numerous cooperators, who are world experts on classifying and identifying insects and mites. BIOTA addresses two key questions: "What is the correct name of this organism and what is its geographic distribution?" Providing answers now can take scientists many hours and requires access to the world's taxonomic literature. Yet, the correct response is critical for inspectors with USDA's Animal and Plant Health Inspection Service and others at ports of entry who are



on the lookout for incoming insect pests.

Systematic Entomology Lab, Washington, DC  
Thomas Henry/Manya Stoetzel, (202) 382-1780/(301)  
504-5183

Farmers will soon have a new computerized way to select profitable crops and other farming practices that minimize damage to the environment. Called a decision support system, it will help farmers use a computer to design and run "what if" scenarios. This will help them select farming options that maximize profit while reducing potential for erosion and water pollution. For example, a farmer who grows corn every year could use the computer to compare how alternating corn with soybeans might decrease the use of nitrogen fertilizer and generate more income. Now, in its final pilot testing, the new tool is called the "USDA Water Quality MODeST" (short for "multiple objective decision support tool"). Similar systems could be developed for farmers and ranchers worldwide. MODeST marks the first coupling of decision-making models with complex models that simulate natural processes—like crop growth and chemical movement—and project farm income.

Southwest Watershed Research Center, Tucson, AZ  
Diana S. Yakowitz/Jeff Stone, (520) 670-6481

### IPM/Biological Control

A tiny nematode, *Steinernema glaseri*, is a golfers' best friend in the battle against the destructive larvae of the Japanese beetle, *Popillia japonica*. Commonly called "white grub," Japanese beetle larvae feast on the roots of turf found on golf courses, cemeteries and homeowner's lawns. The adults are serious pests of flowers, ornamentals, fruit and fruit trees. The nematode kills the grub by entering its body through its mouth parts. It then releases a bacteria, *Xenorhabdus poinarii*, into the grub's bloodstream. The bacteria kills the grub within 24 hours. The use of nematodes to control white grubs has been relatively successful in field trials where *S. glaseri* killed up to 50 percent of the white grubs in a 10-square-foot area. Scientists are currently perfecting the delivery system for *S. glaseri* and hope to have it ready to market to the public in the next two years.

Application Technology Lab, Wooster, OH  
Michael Klein, (216) 263-3896

Natural strains of bacteria discovered by scientists could give dairy producers new alternatives to insecticides that protect calves from stable flies and houseflies. Flies infest the animals' sawdust bedding, biting them and feeding on blood. This causes stress and slows the calves' growth. In the bedding, however, ARS and Cornell University researchers discovered 49 strains of *Bacillus thuringiensis* (Bt) bacteria. At least two of the

strains are previously unknown. In preliminary tests, scientists fed the flies' immature offspring, or larvae, a lab diet laced with Bt. The pests soon stopped eating and died, because the bacterium makes a toxin that punches holes in their stomach cells. The toxin is harmless to humans, animals and beneficial insects. Once scientists identify the top candidate Bt's for commercialization, the bacteria could be mixed in fly baits or sprays for calf pens and bedding.

Insect Biocontrol Lab, Beltsville, MD  
Phyllis Martin, (301) 504-6331

Computers and a genetically engineered, glow-in-the-dark bacterium are helping pave the way to a chemical-free, natural control for underground fungi that attack plant seeds and roots. Eventually, ARS researchers want farmers to be able to use seed coated with such natural strains of bacteria as *Enterobacter cloacae*. The bacterium suppresses "damping-off" diseases caused by the harmful fungus *Pythium ultimum*. However, scientists need to pinpoint where, when and how the helpful—but invisible—bacterium colonizes roots and persists in soil. The scientists' approach began with inserting genes from a bioluminescent bacteria species into *E. cloacae*. These genes allow the modified bacterium to glow in the dark. This lets scientists do something virtually impossible under field conditions. They can photograph the bacterium's exact whereabouts in a laboratory "root box" used to study root development. Next, they convert the photos into computerized images. These are later color-coded to better distinguish seed, roots, soil and bacteria. The scientists can then analyze the images to determine bacteria's extent and location relative to plant roots.

Biocontrol of Plant Diseases Lab, Beltsville, MD  
Daniel P. Roberts, (301) 504-5680

The sex life of a tropical fungus may provide insight into how fungal genes control biological processes. *Hypocrea poronioidea*, rediscovered during a biological survey of the rainforest in Puerto Rico, is the seldom-seen sexual state of a genus of important beneficial fungi, *Trichoderma*. Strains of *Trichoderma* are used to produce enzymes that degrade fibers, or as biological controls of plant diseases caused by other fungi. ARS scientists identified *H. poronioidea* and grew it in the laboratory for the first time. They recognized it as a species of *Trichoderma*, even though most trichodermas are not known to have any sexual phase. Because the new fungus goes through the whole life cycle, it offers the possibility of studying how *Trichoderma* works as a biofungicide. Scientists may also be able to improve *Trichoderma* species by sexual reproduction to better fight crop diseases and may be better able to exploit the commercial potential of *Trichoderma* species to produce enzymes that degrade cellulose and lignin, key



components in cotton and wood fibers.

*Systematic Botany and Mycology Lab, Beltsville, MD*  
Gary J. Samuels, (301) 504-5364

## Crop Diseases and Pests

**A newly released breeding line of citrus resists the citrus tristeza virus (CTV).** The new line, developed by an ARS plant breeder and dubbed US 119, is being used to breed citrus varieties that fight off the virus. CTV-resistant citrus is more important than ever, because in November 1995, the brown citrus aphid was found in Fort Lauderdale, FL. This aphid carries severe strains of CTV that are not present in Florida, and the pest transmits the virus when it feeds on citrus trees. Scientists and citrus industry leaders have worked for several years to prepare for the potential arrival of this pest in Florida citrus groves. It has been estimated that the aphid could cost the citrus industry more than \$1 billion over the next few years.

*Horticultural Research Lab, Orlando, FL*  
Herb C. Barrett, (407) 897-7300

**Abamectin, a natural ingredient produced by a common soil microorganism, knocks out the pesky Caribbean fruit fly.** Produced by the fungus *Streptomyces avermitilis*, this biological bait additive could be a possible alternative to malathion, the insecticide growers now use against the carib fly. Currently the only alternative to malathion is methyl bromide, which is being phased out in 2001. Abamectin, which breaks down rapidly, works by paralyzing the fly's nervous system, leading to death. In lab tests, the abamectin-laced bait was 100 percent effective at 50 parts per million, only 0.03 percent of the amount of malathion needed to do the same job. Another form of abamectin is registered for use against Florida's citrus rust mite. ARS scientists are applying for a patent and are looking for ways to commercialize the product. The new bait can be applied with the same equipment now used for malathion. Fresh citrus shipped to Japan, Thailand, California, Texas, Bermuda and Hawaii must be certified free of the Caribbean fruit fly.

*Subtropical Horticulture Research Lab, Miami, FL*  
Michael Hennessey/Jimmie King, (305) 254-3627

**A light-activated dye kills Mediterranean and oriental fruit flies,** ARS scientists have shown for the first time. Earlier work, at Mississippi State University and elsewhere, proved that photoactive colorants called xanthenes can zap other insect pests. Now, ARS researchers and PhotoDye International, Inc., are seeking a patent to use xanthenes such as FDA-approved D&C red number 28 to kill the two fruit flies. The dye could be mixed with a bait and another dye to make the meal even

more lethal. In the past five years, U.S. taxpayers have spent more than \$100 million to fight Medflies and oriental fruit flies in mainland states such as California. The dye goes into action after the flies eat it and then spend time in the sun. Scientists think that the compounds, when light-activated, release a form of oxygen that is toxic to these insects. (PATENT APPLICATIONS 08/353,726 and 08/414,402)

*Tropical Fruit and Vegetable Research Lab, Hilo, HI*  
Nicanor J. Liquido, (808) 959-4344

**The Mediterranean fruit fly's habit of approaching an alluring scent indirectly, instead of straight-on, is key to a new trap.** Hung from trees, the device has three removable panels spaced approximately an inch apart. Medflies are attracted by the slow-release lure impregnated in the middle panel, a six-by-six-inch plastic square. Heading to or from the scent's source, the flies can get nabbed by the sticky coating on the two outer panels that are made of nine-by-5.5-inch paper-board. When medflies invade states like California or Florida, the new trap could be used to find their invasion boundaries. Then agricultural agencies can map a counterattack. Today's sticky traps consist of a single panel with medfly lure mixed into the coating. These traps may run out of lure in two weeks. The new traps, with a controlled-release lure, last about two months or more, according to preliminary outdoor tests. ARS and Farma Tech International, Fresno, CA, invented the trap. (PATENT APPLICATION 08/248,365)

*Tropical Fruit and Vegetable Research Lab, Hilo, HI*  
Roy T. Cunningham, (808) 959-4300

**To keep corn free of a toxin made by a fungus, farmers might someday plant seeds coated with a harmless bacterium.** ARS researchers discovered that the fungus and bacterium are endophytes—natural inhabitants of corn plants rather than "outsiders." If further tests succeed, *Enterobacter cloacae* bacteria applied to corn seed would enter and spread through the plant after it germinates. This is how the bacterium gave corn plants a built-in defense against the fungus, *Fusarium moniliforme*, in greenhouse tests and small outdoor trials by ARS and University of Georgia scientists. *F. moniliforme* and related fungi infect many grain, fruit and vegetable crops. The fungi also make fumonisins—toxins blamed for contaminating corn-based feeds and foods. Previously, scientists thought the fungus was always a pathogen. But ARS researchers found that it is not always a pathogen. They found it inside nearly all commercial corn cultivars they examined. In a seed sample from Italy, however, they found only endophytic bacteria—no fungi. Scientists don't yet know if the *E. cloacae* bacteria actually attack fungal cells, or simply outcompete them for living space inside the corn plant. The scientists plan larger outdoor tests



next summer.

*Toxicology and Mycotoxin Research, Athens, GA*  
Charles Bacon, (706) 546-3158

### Crop Productivity

**A new line of long grain rice that fends off two key fungal diseases has been released to breeders and seed companies.** Few cultivars grown today by American farmers can withstand both of the diseases. ARS researchers developed, tested and released the line, dubbed B82-761. It resists *Rhizoctonia solani* and nine races of *Pyricularia grisea*. *R. solani* causes sheath blight; *P. grisea* is the culprit behind a disease called blast. Throughout the South, the two diseases can cause yield losses of 10 to 50 percent in rice fields. Breeders can use B82-761 to develop rice that fends off both. ARS scientists produced the resistant line by crossing Vista, a medium grain rice, with Lebonnet, a long grain variety. In 1992-93 field tests, it showed better disease resistance than Gulfmont, Lemont and other leading commercial cultivars. Plants of B82-761 grow four-and-one-half-feet high and mature in about 17 weeks. The grain is high in amylose, is an important starch component, and has excellent cooking and processing properties.

*Rice Research, Beaumont, TX*  
Anna M. McClung, (409) 752-5221

**Black Ruby is a new Japanese-type plum that grows well in the humid climate of the southeastern United States.** Bearing large, high-quality fruit in late June to early July, this plum has reddish-black skin and firm, yellow flesh. Black Ruby withstands plum leaf scald and is moderately resistant to bacterial diseases that attack plums in the southeast. Trees will be available this winter from nurseries in Tennessee and are recommended for testing in states that have a similar climate.

*Southeastern Fruit and Tree Nut Research Lab,*  
*Byron, GA*  
W.R. Okie, (912) 956-6405

**A new, automated system for applying pesticide on greenhouse plants eliminates the need for hand-held sprayers.** Under standard safety regulations, greenhouse workers must wear masks and heavy protective suits. But in a hot, humid greenhouse, the temperature inside a protective suit can quickly soar to the boiling point. That can lead to dizziness and fainting. To eliminate this hazard, ARS mechanical engineers built a system in which compressed air forces pesticides through flexible pipes and special nozzles, misting the chemicals onto plants. A worker only mixes the pesticide with water according to the manufacturer's specifications, then flips a toggle switch. This tempo-

rally closes the greenhouse's exhaust fans and ceiling windows, preventing pesticides from escaping. The new system can be set—using a delay timer—to spray at night or on weekends. In tests in research greenhouses, it reduced the annual cost of pesticide and related-application costs—from \$1,400 to \$130 per greenhouse. The new system could also benefit commercial greenhouses, in which pesticides are sprayed to curb plant pests.

*Crop Science Research Lab, Mississippi State, MS*  
Johnie Jenkins/Stam Malone/Quinnia Yates, (601) 323-2230

**Valuable cowpea germplasm from Africa is now available to plant breeders.** This new germplasm has great potential because it was collected in Botswana—considered the center of origin for cowpeas. ARS scientists screened 109 accessions and declared them free of foreign viruses that could infect domestic varieties. Another 100 germplasm lines are being checked for viruses in quarantine at St. Croix and are expected to be released by early 1996. Breeders will be able to tap the germplasm for insect and disease resistance—without fear of the seed being contaminated by harmful viruses. Cowpeas, also called southern peas in the United States, include the popular black-eyed peas often served with meat and rice dishes.

*Plant Genetic Resources Conservation, Griffin, GA*  
A. Graves Gillaspie, (770) 412-4777

**Wheat farmers can't stop untimely rain, but an ARS discovery could someday help them prevent the storms from making wheat kernels sprout prematurely.** In the Pacific Northwest, rains come just before harvest about one year in five. That can cause ripe wheat kernels to sprout while they're still on the grain head. The sprouting reduces quality—and value—of wheat flour for bread, cakes and noodles. ARS scientists found the part of the hormone abscisic acid, called the 7-methyl group, that tells the wheat kernel not to sprout. The next step is to discover what part of the kernel, or seed, receives this message. With both pieces, scientists should be able to increase the effectiveness of this hormonal signal, preventing grain quality losses.

*Wheat Genetics, Quality, Physiology and Disease Research, Pullman, WA*  
Kay Simmons, (509) 335-3632

**Floodwaters are being harnessed to disperse seeds of nutritious grasses and shrubs along rangeland waterways that are usually dry.** On the Jornada Experimental Range in New Mexico, scientists rigged seed containers on poles stuck into dry streambeds. As water from infrequent storms flows past, it trips open the container, slowly releasing seeds. Downstream, the seeds settle, germinate and grow. These waterways are the most favorable sites for successful seed germination because



they receive more moisture, organic matter, soil and nutrients from the surrounding areas. Scientists have successfully dispersed and germinated alkali sacaton, blue panicgrass, other grasses and fourwing saltbush, a shrub. In another tactic under study, scientists are using a portable watering system to insure that desirable grasses and shrubs are established in the dry waterways. These serve as "living seed sources" that floodwater harvests and re-sows downstream. These natural methods are low-cost, highly efficient ways to increase the value of native western rangelands.

*Rangeland Management Research, Las Cruces, NM*  
*Jerry R. Barrow, (505) 646-7015*

**Tractor-mounted planters that sport an ARS-designed accessory will help growers plant seeds only where they'll get enough water for a good start.** Seeds placed in too-dry soil will shrivel; too-wet soil encourages rot. And, planting seed uniformly at the proper depth is as crucial as proper moisture. Both tasks are automated by the invention—an integrated system of probes and hydraulics that attaches to a tractor-drawn planter. Electrical current flowing between two rugged, soil-probing electrodes is monitored continuously. The stronger the current, the more water available for seeds. In response, a feedback system linked to the tractor's hydraulics lowers or raises the planter's scraper blade. The blade descends—to push more soil out of the way—if the planting site is droughty. If the electrodes detect soil that's too wet, the blade rises to seek drier soil. Once the blade exposes the appropriate surface, seeds are planted at the depth chosen by the grower. The invention is intended for growers who plant seeds into raised seedbeds or ridges already wetted with rain or a pre-plant irrigation. (PATENT APPLICATION 08/352,650)

*Western Integrated Cropping Systems Research,*  
*Shafter, CA*

*Lyle M. Carter, (805) 746-6391*

**Degraded rangeland recovers just as quickly with a managed, moderate level of cattle grazing as with no grazing at all.** ARS scientists came to this conclusion by comparing data collected in 1936, 1991 and 1993. Overgrazing in the early part of the century damaged rangeland across eastern Oregon. Later, in the 1930s, cattle were excluded from 13 five-acre research plots located throughout the 16,000-acre Northern Great Basin Experimental Range in southeastern Oregon. In the 1990s, scientists looked for differences between grazed and ungrazed plots. They found that plants and soil in both types of sites had recovered, with comparable shrubs, grasses and wildflowers in each. Grazed areas had smaller plants, but more of them.

*Sustainable Management of Great Basin Rangelands,*  
*Burns, OR*

*Tony Svejcar, (503) 573-2064*

## Genetic Resources

**New, genetically engineered plum plants resist the devastating plum pox virus,** thanks to five years of research to protect U.S. fruit growers from this deadly disease. Plum pox virus has not been found in North America, but is rampant throughout European orchards and was recently discovered in South America. There is no known control for the virus, which attacks plums, apricots and peaches and is spread by aphids and grafting. To create the transgenic plants, ARS scientists injected healthy plum plants with a gene from the coat protein surrounding the virus. After two years of tests, one breeding line appears to have complete immunity to the virus. USDA's Animal and Plant Health Inspection Service collaborated on the research.

*Appalachian Fruit Research Station,*  
*Kearneysville, WV*

*Ralph Scorza, (304) 725-3451*

**A damaging virus that infects grape germplasm can now be detected in two days** instead of the usual three or four years. The technique detects strains 3 and 4 of the grapevine leafroll virus if it's hiding in grape vine cuttings imported from other countries. Now, to make sure these imported cuttings are virus-free, scientists must grow them in quarantine for three to four years. It takes that long for visible signs of the virus to appear on vine leaves. This creates a bottleneck for scientists who want to see if the foreign germplasm contains genetic resistance for disease, insects and other traits, or shows superior performance in current or potential grape production areas in the United States. The new test, developed by ARS and Cornell University researchers, eases the logjam by giving scientists a quick way to detect grapevines infected with the virus. Tests for other grape viruses are being developed.

*Plant Genetic Resources, Geneva, NY*

*Philip L. Forsline, (315) 787-2390*

**DNA fingerprinting can be used to differentiate between strains of a Jekyll and Hyde fungus** that's a pest of vegetables and fruits. If a destructive strain is identified, steps can be taken to control it. Usually the fungus, *Phomopsis*, is dormant and harmless. But under the right conditions—often unknowingly created by humans—some strains can become a devastating plant pathogen. One such outbreak, from 1989 to 1991, resulted in *Phomopsis*-related losses in U.S. soybeans alone totaling over \$500 million. The fungus is tough to combat because, its simple form and structure have masked clues to understanding which strains may become active. ARS experts examined DNA fingerprinting of 43 strains of the fungus from a wide variety of plants from North America and the Caribbean. They



discovered some nasty strains have an extremely broad host range—contrary to the belief the fungus attacked only specific crops. As a result of the research, the DNA work will help plant quarantine officials at ports of entry keep the fungus from entering the country.

*Systematic Botany and Mycology, Beltsville, MD*  
Amy Rossman/Steve Rehner, (301) 504-5364

## Animal Diseases and Pests

Cats are the most likely source of a parasitic *Toxoplasma gondii* infection on hog farms, a survey shows. This is a public health concern because humans can become infected through handling or consuming raw or undercooked pork containing the parasite. If a pregnant woman becomes infected with *T. gondii*, her baby could be born blind, mentally retarded or with other severe health problems. ARS and University of Illinois researchers surveyed 47 Illinois farms, checking feed, soil, water and blood samples of swine, cats and wildlife around the farms. Sixty-seven percent of the 300-plus cats checked showed signs of previous exposure to *T. gondii*. After becoming infected, a cat sheds millions of parasite eggs called oocysts in its feces for about a week. If the parasite-laden feces come in contact with swine feed, hogs can swallow the oocysts and become infected. The scientists' recommendation: Keep farm feed supplies covered and out of reach of wandering cats.

*Parasite Biology and Epidemiology, Beltsville, MD*  
J.P. Dubey, (301) 504-8128

A genetically-engineered protein provides a rapid, sensitive test for diagnosing in pigs the organism that causes human trichinosis. This disease is caused by eating raw or undercooked meat, generally pork, that contains the parasitic nematode *Trichinella spiralis*. The disease poses a public health risk worldwide. ARS scientists isolated a naturally-derived parasite protein, called an antigen, that triggers the body's immune system to send out antibodies to fight off the parasite. In field studies, the natural antigen detected 98 percent of the medically significant cases in experimentally infected swine. To improve the test, scientists have copied and produced the parasite's gene that makes the antigen. The improved antigen will aid the pork industry in making Trichinae-free pork available to consumers. In 1985, the National Pork Producers Council estimated that being able to assure consumers of trichinella-free pork would boost domestic demand by two percent and exports by 33 percent—gains worth about \$450 million yearly to pork producers. (PATENT 5,422,263)

*Immunology and Disease Resistance Lab,*  
Beltsville, MD  
Dante Zarlenga/H. Ray Gamble, (301) 504-8979/8300

A feed additive made from sugar beets could help poultry producers win the \$300-million-a-year battle against coccidiosis in their flocks. Producers now try to control this parasite-related disease primarily with drugs. But the parasite's increasing resistance to the drugs has intensified the search for other weapons. Field tests have shown feeding chickens the additive betaine in combination with an anticoccidial drug can help alleviate the weight loss, poor feed efficiency and intestinal disorders associated with coccidia infection. While betaine is not believed to be directly toxic to coccidia, it interferes with the parasite's ability to infect the birds' intestinal cells. When chickens ate medicated feed containing 1.5 to three pounds of betaine per ton, intestinal invasion by the parasites was 50 to 90 percent lower than in birds not given betaine in the feed, and parasite development was significantly hindered. Another plus: Researchers say betaine also helps improve the birds' digestion of nutrients.

*Parasite Biology and Epidemiology Lab,*  
Beltsville, MD  
Patricia C. Augustine, (301) 504-8428

Cows infected with the *Neospora caninum* may abort a calf once, but seldom a second time. So there's no reason to send the cow to slaughter. That's the latest word from researchers studying this new parasite, discovered and named by ARS researchers in 1988. Since then, *N. caninum* has been pinpointed as a major cause of dairy cattle abortions in several countries, including the United States, the Netherlands, Australia and New Zealand. In California, more than 25 percent of all dairy cattle abortions in the past five years were caused by *N. caninum*. Abortion can occur at any time during gestation. Sometimes calves are born weak and paralyzed and die within a week. Some heifers are born infected and free of symptoms, but subsequently give birth to infected calves. Cows that become infected and abort a calf remain clinically normal. ARS researchers have developed a test to diagnose neosporosis, but no vaccine or treatment exists.

*Parasite Biology and Epidemiology Lab,*  
Beltsville, MD  
J.P. Dubey, (301) 504-8128

ARS researchers are staying one jump ahead of a relatively new bacterium that causes abortions in livestock and intestinal upset in people. In 1992, a Belgian scientist first identified and named *Arcobacter*, a close relative of *Campylobacter*. Both species require only a small amount of oxygen to grow, making culturing in the laboratory very difficult. Because of their close genetic relationship, they are confusing to laboratory diagnosticians. To help simplify identification, ARS researchers first developed DNA probes and then made primers to use in methods that make identification



accurate and quick.

*National Animal Disease Center, Ames, IA  
Irene V. Wesley, (515) 239-8291*

**A new genetic probe has been identified that may be useful for detecting in cattle's blood and feces the bacterium causing Johne's disease, a killer of dairy cattle.** No treatment is available for Johne's disease, so identifying and removing infected animals from the herd is the primary means of control. To help find those animals, researchers developed a diagnostic probe from a segment of genetic material, called DNA, from *Mycobacterium paratuberculosis*. The probe binds with *M. paratuberculosis*, distinguishing it from other related bacteria. Plans are to compare the probe's performance with IS-900, the diagnostic test now used by laboratories. Cows with Johne's disease have chronic diarrhea and suffer massive weight losses that inevitably lead to death. Some infected cows show no signs of disease, but spread the organism through their feces or to their calves via contaminated udders.

*National Animal Disease Center, Ames, IA  
Judith Stabel, (515) 239-8304*

**Simple and easy-to-use staining techniques have been adapted for use in studies of the form and structure of roundworms—physical characteristics that are obscure and difficult to evaluate.** A liquid stain using silver nitrate identifies surface characteristics of roundworms that infect cattle and sheep. A second red stain, using carmine-propionic acid, highlights their internal cellular structure. Together, these two new staining techniques improve the efficiency of identifying these parasites that include trichostrongyloid and other nematodes that cause cattle and sheep ranchers losses of more than \$400 million annually. Russian scientists from the K.I. Skryabin Institute of Helminthology, Moscow, and ARS researchers developed the staining techniques and are the first to apply them to study surface characteristics of these roundworms. The techniques provide a low-cost yet powerful tool for diagnostic and systematic research of roundworms, and may eliminate the need for more advanced methods of microscopy not available in many laboratories. The tests also may be applied to other types of parasitic worms.

*Biosystematic Parasitology Lab, Beltsville, MD  
Eric Hoberg/Alexander Khrustalev, (301) 504-8588*

**A new brucellosis vaccine, called RB51, lets veterinarians tell the difference between livestock that have been vaccinated and those that have been infected naturally.** This vaccine is missing a part of *Brucella abortus*, the bacterium behind brucellosis. Result: The immune system of animals receiving the new vaccine doesn't produce the same antibodies as naturally infected animals. Developed by a Virginia Polytechnic Institute

researcher and tested by ARS scientists and Colorado Serum Co. in Denver, the vaccine worked well in tests with cattle. Brucellosis costs the U.S. cattle industry an estimated \$30 million annually. Current commercial vaccines are effective, but stimulate the animal's immune system to produce the same antibodies as natural infection, making it impossible to sort out vaccinated from infected animals. Brucellosis causes abortion and reduced milk production in cattle, sheep and goats.

*Brucellosis Research, Ames, IA  
Mark G. Stevens, (515) 239-8313*

## Animal Productivity

**Gulf Coast Natives, sheep with historic links to long-ago French and Spanish settlers, could help provide a new livestock option for Southern farmers.** These wool-type sheep are part of a cooperative ARS-Louisiana State University breeding program to produce a new composite sheep breed to withstand the Mid-South's steamy summers and prolific parasite population. Descended from sheep brought to North America by early French and Spanish explorers and settlers, the Gulf Coast Natives have unusually high resistance to parasite infestation and can tolerate high temperatures and humidity better than other breeds. In their breeding program, ARS scientists also are using Dorset sheep, an English breed; St. Croix, a tropical breed with good heat tolerance and parasite resistance; Polypay, a composite U.S. breed; and Texel and Romanov sheep to add size to the mix. St. Croix sheep offer the advantage of producing hair rather than wool. While the hair has no market value, wool markets are often too far away to make wool sales feasible for Southern producers, who still must face the expense of having wool sheep sheared. In the first phase of the crossbreeding program, three-breed lambs have grown well from birth to weaning.

*South Central Family Farm Research Center,  
Booneville, AR  
Michael A. Brown, (501) 675-3834*

**Feeding unmarketable onions to hungry sheep is a safe way to recycle what otherwise is destined for the landfill.** ARS scientists found that sheep gained as much weight when fed onions as when fed expensive feed grains. For the onion grower, the practice would turn a liability into a money maker; for the sheep producer, it supplies a cheap source of nutritious feed. American farmers produce nearly three million tons of onions each year, and many don't make it to market. In some years, bumper crops far exceed market demand. Also, in some areas up to a 40 percent of the onions have to be discarded because they are too small or otherwise don't meet standards. Growers also must remove



unharvested onions from a field to keep them from becoming reservoirs for plant disease. Luckily, many onion-growing areas also produce sheep.

*Range Management Research, Las Cruces, NM  
Rick Estell, (505) 646-6332*

## Soil, Water and Air Quality

A new use for gypsum-containing byproducts from coal-burning electric power plants could make acidic soils more productive. In an ARS greenhouse study, corn grew two to three times better when gypsum byproducts were added to acid soil. The gypsum provides calcium, reducing the effects of soil acidity and aluminum toxicity commonly found in acid soils. Scientists tested 16 byproducts from coal-burning power plants and found three high-gypsum byproducts that hold promise as inexpensive materials for use on farmland. All were safe to use when mixed in soils at appropriate levels. At optimum levels, all three byproducts not only increased root length but also grew plants with the fine, extensive, highly branched roots that mark a healthy plant. Plants grown on highly acid soils normally produce short, stubby roots.

*Appalachian Soil and Water Conservation Research  
Lab, Beckley, WV  
Ralph B. Clark, (304) 252-6426, extension 2854*

Photographing the tiny spaces where soil microbes live provides scientists with a powerful new tool for determining a soil's health. Researchers take a picture of a soil sliver, encased in a resin coating, then scan the photo by computer to determine the shape of soil pores. These tiny openings hold water and provide a home for microbes that keep soil healthy. Scientists use a new kind of mathematics, called fractal geometry, to examine the roughness of the pore surfaces to determine soil quality, as part of a long-term study of organic versus conventional farming at the Rodale Research Center in Emmaus, PA. ARS scientists believe there is an ideal soil pore roughness that provides just the right amount of room for water and the beneficial microbes. So far, they've found that fields where legumes are grown as green manure had better pore roughness than fields receiving manure or fertilizer.

*Soil-Microbial Systems Lab, Beltsville, MD  
Larry J. Sikora, (301) 504-9384  
Systems Research Lab, Beltsville, MD  
Yakov Pachepsky, (301) 504-5872*

Microwave radiation produced by soil and measured by satellites could one day tell farmers how much moisture has been lost in their fields. As a possible model for satellite use, NASA and ARS scientists are

testing two large antennae on a boom raised 80 feet above a farm field. The antennae measure soil moisture changes over the entire field by recording natural microwave emissions from the soil 24 hours a day. The more water present, the lower the emissions from the surface. Researchers connected the antennae to sensors tuned to microwave frequencies best suited for measuring water at depths of one to two inches. Scientists then correlate these to soil moisture conditions deeper in the soil. Measurements have been recorded in Beltsville, MD, since 1983, and began in Davis, CA, last summer. Satellite measurements were most accurate around 6 a.m. and 6 p.m., representing two moisture extremes. Hydrology Lab, Beltsville, MD  
Thomas J. Jackson, (301) 504-8511

Cover crops planted under trees in orchards reduce soil erosion and protect the groundwater. The cover crops' roots continually die and regenerate, providing a carbon-based food supply for soil microorganisms that help break down pesticides before they reach groundwater. Ground covers also use some of the available soil nutrients, limiting a young tree's excess growth of shoots and leaves and reducing the need for pruning. Excessive vegetative growth can reduce fruit yield by shading the lower part of the tree, decreasing the tree's total number of blooms.

*Appalachian Fruit Research Station,  
Kearneysville, WV  
D. Michael Glenn, (304) 725-3451*

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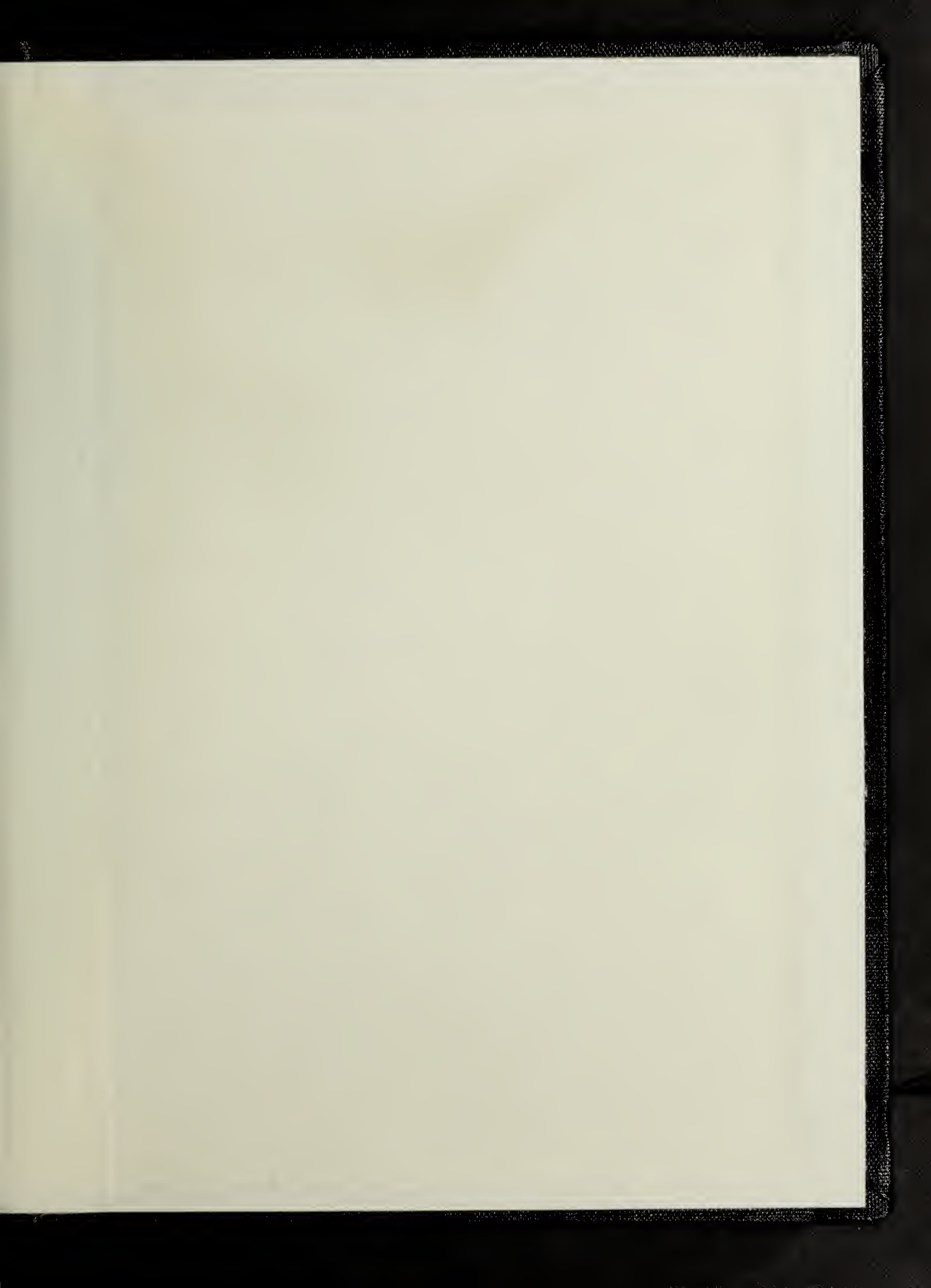
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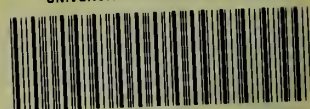


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